Vol. 12, No. 4
February 28, 1987

Energy Research Abstracts

Abstracts 7868-8804

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

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Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

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Buildings Energy Technology (BET)–**PB87-900700.** Technology required for energy conservation in buildings of all types.

Coal-Based Synfuels (CBS)–**PB87-901400.** Conversion of coal into gaseous or liquid fuels.

Coal Combustion and Utilization (CCU)–**PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

Coal Preparation and Pollution Control (CPC)–**PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

Direct Energy Conversion (DEC)–**PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

Energy from Biomass (EFB)–**PB87-900600.** Biomass production, conversion, and utilization for energy.

Geothermal Energy Technology (GET)–**PB87-914700.** Exploration, development, and utilization of geothermal resources.

Heavy-Ion Reactions (HIR)–**PB87-900500.** Heavy-ion (A > 4) reactions.

Laser Research (LAR)–**PB87-901100.** Laser research and development, excluding applications.

Nuclear Fuel Cycle (NFC)–**PB87-913400.** Both front and back ends of the nuclear fuel cycle.

Nuclear Reactor Safety (NRS)–**PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

Radioactive Waste Management (RWM)–**PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

Solar Thermal Energy Technology (STT)–**PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

Transportation Energy Research (TER)–**PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

Unconventional Petroleum (UCP)–**PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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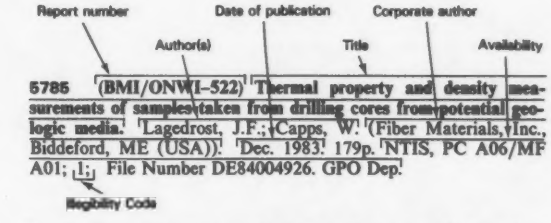
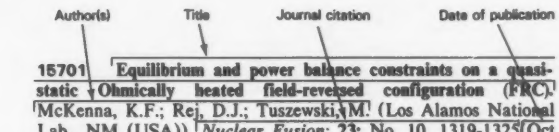
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
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• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
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Bethesda, MD

NOVA Information Services Company
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Plenum Publishing Corporation
New York, NY

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Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 41 first-level and 276 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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0103 Preparation

REFER ALSO TO CITATION(S) 7910

7868 (DOE/FE/60181—2125) Coal/water slurry preparation: Final report for the period ending June 30, 1986. Wilson, W.G.; Baker, G.G.; Maas, D.J.; Potas, T.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Sep 1986. Contract FC21-83FE60181. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87001013.

Raw low-rank coal/water slurries, primarily due to the high inherent moisture, have such low energy densities that they cannot be economically utilized. However, hot-water drying (HWD) permanently removes the inherent moisture and some oxygen, allowing dramatic improvements in the resulting slurry energy density. This process results in the coal essentially being slurried in its own moisture and produces a liquid fuel with approximately the same heating value as the parent coal. Elevated process temperatures cause the low-rank coals to undergo both chemical and physical changes, which include decarboxylation, mild pyrolysis, dehydration, and surface modification. Tars and waxes also form and flow to the coal surface where they solidify upon cooling and plug micropore entrances. As a result, lignite and subbituminous coals acquire surface characteristics and improved coal quality, which allow the preparation and utilization of concentrated low-rank coal/water fuels. Improvement of the energy density of HWD coal/water fuels versus those prepared with the raw coal are typically >30%. Conceptual economic studies have determined the cost to process Wyoming subbituminous coal into a 60 wt % CWS to be $1.40/MMBtu (Bechtel National Inc.), $2.20/MMBtu (UNDERC) and for processing Australian brown coal $2.00/MMBtu (Davy McKee Pacific). 18 refs., 21 figs., 8 tabs.

7869 (DOE/PC/70796—10) Effect of maceral properties on the comminution of coal. Technical progress report, July 1-September 30, 1986. Bodily, D.M. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). 1986. Contract FG22-84PC70796. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002298.

A coal rich in bituminite from the Cedar City, Utah area was obtained, ground and the swelling characteristics studied. The swelling of the coal is similar to that of other coals, showing maximum swelling in pyridine, with another maximum for tetrahydrofuran (THF). Two new solvents were studied to better define the swelling versus solubility parameter curves. A plot of the swelling for Hiawatha coal using pyridine, THF, acetone, toluene, cyclohexane, methanol, ethanol, dichloromethane, and water as solvents is presented. The swelling of the coal in dichloromethane is less than in acetone and pyridine. Ethanol has a solubility parameter between pyridine and methanol and causes swelling slightly greater than methanol. The Cedar City coal was separated by density gradient centrifugation. The density distribution is shown in figure 3. The density of bituminite is in the range 1.1 to 1.2 g/cm^3. This is greater than the density of the resinite sample previously studied. 3 figs., 1 tab.

0104 Processing

REFER ALSO TO CITATION(S) 7885, 7896, 7992, 7993, 8029

7870 (DOE/FE/55014—T24) Great Plains coal gasification project: Quarterly technical progress report, Third quarter 1986. (ANG Coal Gasification Co., Beulah, ND (USA)). 31 Oct 1986. Contract FM02-82FE55014. 132p. NTIS, PC A07. File Number DE87002800.

Accomplishments for the third quarter of 1986 are presented for the Great Plains coal gasification plant. The following areas are discussed: (1) lignite coal production; (2) SNG production; (3) SNG gas quality; (4) by-products production and inventories; (5) onstream factors; (6) raw material, product and by-product consumption and energy consumption for plant operations; (7) plant modifications - 1986 budget; (8) plant maintenance; (9) safety; (10) industrial hygiene; (11) medical services; (12) environmental executive summary; and (13) quality assurance/quality control activities.

7871 (DOE/MC/22059—T2) Entrained-flow gasification at elevated pressure: Quarterly technical progress report No. 2 for the period 1 June 1985 to 31 August 1985. Lindsay, J.D.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 30 Sep 1985. Contract AC21-85MC22059. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86000525.

The three main tasks of the contract are: (1) entrained coal gasification measurements, which includes elevated pressure tests of four coal types, investigation of injector design, cold-flow measurements in simulated gasifier flows, and investigation of advanced optical diagnostic techniques that could be applied to gasification measurements; (2) improvement of the one- and two-dimensional computer codes for gasification processes, including improvement of physical submodels and numerical methods, and comparison of model predictions with experimental results for code validation; and (3) application of results to industrial and METC needs through technical seminars, expansion of a detailed data book, and distribution of the code to other users, especially METC. Concerning task 1, gasifier measurements, the installation of the BYU gasifier into the new Combustion and Reactions Laboratory was completed, and checkout tests with methane flames were conducted. Elevated pressure tests and injector characterization tests are now planned. Several test coals have been prepared for use in the elevated pressure tests and injector characterization tests. The cold flow test program, which is designed to acquire gasifier flow field data to validate the fluid-mechanics submodel of PCGC-2, has been nearly completed. For task 2, a major revision of the particle dispersion submodel of PCGC-2 is underway in which Lagrangian equations for particle number-density will be solved simultaneously with other Lagrangian variables. Use of these Lagrangian particle density calculations are expected to significantly increase the accuracy of particle phase calculations. Improved accuracy in the char-oxidation kinetic constants used by PCGC-2 has been obtained through rigorous analysis of original data. Under task 3, work is continuing on updating the databook. A command program has been written to make PCGC-2 use more convenient. 31 refs., 9 figs.

7872 (DOE/METC—86/2027) The gas METC [Morgantown Energy Technology Center] 42-inch fixed-bed coal gasifier and gas cleanup train: Volume 2, Test runs 101 through 104: Final technical report. Pater, K. Jr. (USDOE Morgantown Energy Technology Center, WV; Frumerman Associates, Inc., Pittsburgh, PA (USA)). Mar 1986. Contract AC21-83MC20201. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86006577.

The fixed-bed gasifier at the Morgantown Energy Technology Center (METC) of the US Department of Energy (DOE) was first operated in 1967. The broad goal of the gasifier program as it was originally conceived was to develop a gasifier that would process all types of US coal, including caking coals, and that could achieve high throughputs and greater efficiency by operating under pressure. With the passage of time, a further broad objective was recognized and adopted: cleaning the gas thoroughly for use in demanding but potentially very important applications, such as fuel for gas turbines or molten carbonate fuel cells. Runs 101-104 attained some notable accomplishments, and thereby realized most of the broad objectives of the series of runs: (1) The operability of the entire process improved dramatically. (2) The process operated for the first time in the oxygen-blown mode, and two new feedstocks were gasified with only minor problems. (3) Gas was provided for slipstream testing of a hot-gas desulfurization unit and a dirty-gas combustion unit. (4) Five new process control systems were installed that further automated the process and enhanced safety and smooth operation. Eight developmental analytical instruments were also tested during these runs, all with at least partial success. The test program considerably advanced the state of the art in fixed-bed gasification and cleanup of its product gas. A degree of automation worthy of a commercial unit; an operability factor as good as a typical commercial unit; capability of using a spectrum of feedstocks from the lowest- to the highest-rank coals in both air- and oxygen-blown modes; briquette feeding; and a very nearly complete cleanup system with all of the components operable. 5 refs., 12 figs., 22 tabs.

7873 **(DOE/PC/50035—T2) Hydraulic development of centrifugal pumps for coal slurry service: Quarterly technical progress report, July-September 1986.** Kasztejna, P.J.; Cooper, P. (Ingersoll-Rand Co., Phillipsburg, NJ (USA)). 28 Oct 1986. Contract AC22-82PC50035. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002451.

Hydraulic design improvements, systematically studied through extensive comparative testing using a small-scale test rig, were applied to a prototype coal slurry pump. The prototype pump was then comparative wear tested at the same head/capacity conditions with an existing commercial coal liquefaction slurry pump. The prototype pump showed uniform wear that was substantially less than that of the commercial pump which suffered from extensive localized wear as well as general wear. The results of this program indicate that smaller, more efficient, higher specific speed pumps can be utilized for future full scale coal plants; rather than those that would be specified by scaling-up from current pilot plant experience. 5 refs., 19 figs., 7 tabs.

7874 **(DOE/PC/50816—12) Metal boride catalysts for indirect liquefaction: Final technical progress report, for period September 1, 1982 to September 30, 1986.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 15 Oct 1986. Contract FG22-82PC50816. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002303.

The preparation, physical and chemical properties, and CO hydrogenation activity/selectivity behavior of cobalt and iron metal borides were investigated. Over 30 metal boride catalysts were prepared by three different techniques and were characterized by hydrogen and CO adsorptions, x-ray diffraction, temperature-programmed desorption (TPD) of CO, and Moessbauer spectroscopy. Cobalt and iron metal borides were found to have BET surface areas ranging from 4 to 200 m^2/g and percent metal areas ranging from 4 to 100% depending upon preparation. Phases in metal boride catalysts identified by XRD and Moessbauer varied with preparation. In borides prepared by gas phase diborane (DB) reduction, the major phases were cobalt and iron metals; apparently the boron was concentrated at the surface. Borides prepared by $NaBH_4$ or DB/THF reduction consisted mainly of stoichiometric MB and M_3B borides with small amounts of metal present. From CO hydrogenation activity measurements at 175 to 300°C, 1 to 20 atm, the order of decreasing specific activity based on turnover frequencies for cobalt catalysts is CoB(DB/THF) > CoB (DB/H_2) = CoB/Na ($NaBH_4$) = Co > Co/Na. The order or decreasing specific activity for iron catalysts is Fe > FeB/Na > FeB (commercial) > FeB(DB/THF). The products observed during synthesis over CoB catalysts contain lighter hydrocarbons than those produced over CoB/Na and Co catalysts; those observed over FeB catalysts are similar to those produced by unsupported Fe. These and other significant results are presented and discussed. An account of technical communications and publications is also included. 36 refs., 40 figs., 38 tabs.

7875 **(DOE/PC/60036—13) Supercritical fluid extraction of coal: Technical progress report, 9/1/86-11/30/86.** Greenkorn, R.A.; Chao, K.C. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1986. Contract FG22-83PC60036. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002940.

This is the thirteenth progress report on Supercritical Fluid Extraction of Coal. The objectives of the research described in this progress report are to study extraction of coal with supercritical mixtures of ammonia and water and to develop a group contribution equation of state to describe the supercritical region. 7 refs., 1 fig., 3 tabs.

7876 **(NP—7770022) Development of the high-pressure hydrogenation stage of a two-stage coal refinement plant.** Hellwig, U. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Verfahrenstechnik). 31 Jul 1984. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770022.

Batch and semi-continuous experiments have shown that the amount of hydrogenation depended greatly on the mass of the molecular hydrogen supplied to the reactor relative to the mass of asphalt in the extract. The asphaltene and asphaltol were clearly converted in parallel and not in a series reaction, in which asphaltene is first formed from asphaltol. The small number of available measurements however, only permitted a rough estimate of the reaction mechanism to be made. A mechanism similar to extract hydrogenation was also found in indirect liquifaction of coal. The amount of hydrogenation was higher when tetralin was used than with medium oil as solvent. One reason for this was the greater water absorption capacity of the medium oil and another was that tetralin has more hydrogen available than medium oil. In order to transport hydrogen to the radicals of the fluidized bed extract, the presence of a solvent is necessary. The fluidized bed extract has a structure similar to coal, which is why comparable reaction mechanisms can be attributed to indirect liquifaction of coal. In the semi-continuous experiments, the great effect of residence time on the reduction of acids and bases in the distillate oils was shown. For a long residence time, the proportion of acids and bases could be reduced to values below 1%. For a short residence time, the proportion of acids in the distillate oil was greater than in the medium oil used. No effect of the quantity of catalyst on the amount of hydrogenation was found.

7877 **(STEV-BF—86-5-Pt.1) Gasification of peat and biomass. Summary of stages 1-6. Part 1. Experimental activities.** Sjoestroem, K.; Liinanki, L.; Blomkvist, G.; Engstroem, S.; Ekstroem, C.; Loeoew, S. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology; Statens Energiverk, Stockholm (Sweden)). Aug 1985. 109p. (In Swedish). (KTH-KTR—86-15-Pt.1). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750340.

This project deals with the following items of basic research: - study of pyrolysis concerning reaction rates, routes and distribution. - study of the reactivity of the residue of char which is obtained after pyrolysis. - thermal and catalytic decomposition of tar. - studies of catalysts concerning poisoning, sintering, activities etc. The administration and the cost of the project from 1976 to 1983 is reported. (G.B.).

7878 **(STEV-BF—86-5-Pt.2) Gasification of peat and biomass. Summary of stages 1-6. Part 2. Modelling of fluidized bed, gasifier.** Nilsson, T. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology; Statens Energiverk, Stockholm (Sweden)). Aug 1985. 223p. (In Swedish). (KTH-KTR—86-15-Pt.2). NTIS (US Sales Only), PC A10. File Number DE87750341.

This report presents mathematical models and computerized simulation of gasification and pyrolysis, preferably in a fluidized bed. A number of programs and calculations are presented. (G.B.).

7879 (STEV-BF—86-6-Pt.2) Gasification tests with Finnish peat supplied by Kemira. Part 2. Blackadder, W.; Ekstroem, C.; Espenaes, B.G.; Rensfelt, E.; Waldheim, L.; Westergren, B. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 22 Nov 1985. 115p. (STUDSVIK-EB—85-48). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750357.

A series of tests have been performed on Finnish peat samples supplied by Kemira in the experimental, bench scale and pilot units of Studsvik and the Royal Institute of Technology. The results of these tests are reported and concluded. The purpose of these tests was to establish the basis for the application of the MINO process for generation of synthesis gas from peat in Kemira's Oulu plant. In parallel with this study, an engineering study of such a plant has also been performed in cooperation with Linde TVT AG, and has been reported in the form of a proposal to Kemira.

7880 (UCID—20900) User documentation for EQSC. Upadhye, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002726.

EQSC is a simple lumped parameter model for underground coal gasification. It allows the user to specify the feeds to an underground coal deposit, and estimate the products of gasification, product flow rates and temperatures. It also allows the user to input measured or desired product gas composition and adjust some input parameters to get the calculated product composition as close as possible to the one input by the user. This is useful in diagnosing what may be occurring in the underground system. There are many other options which are discussed later. The program has been developed and tested on an HP 1000 computer with HP 2648 type terminal for interactive use. Appendix F contains a brief discussion on porting EQSC to other machines. This manual is divided into the following sections: (1) Introduction; (2) Model Description, Basis and Assumptions; (3) Input File Description; (4) Menu Options; (5) Output Description; (6) Command File for Batch Mode; (7) Sample Problem and Simulated Session; (8) References; and (9) Appendices. 3 refs.

0105 By-products

REFER ALSO TO CITATION(S) 7895

0106 Properties

REFER ALSO TO CITATION(S) 7869, 7892, 7894, 7895, 7898, 7910, 7914, 7918

7881 (DOE/PC/62999—11) Exploratory research on mutagenic activity of coal-related materials using statistical evaluation. (Cincinnati Univ., OH (USA). Kettering Lab.). 31 Oct 1986. Contract AC22-83PC62999. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002254.

The overall objective of this research is to develop integrated methods of chemical and biological analyses for use in the evaluation of potential biohazards associated with coal conversion. To this end the following specific aims have been established: (1) to refine existing techniques of chemical analysis of environmental mixtures by using mutagenicity to identify HPLC fractions of biological interest. (2) To investigate interactive effects of components of coal-derived materials as they affect mutagenicity. (3) To develop statistical methodologies which will permit valid comparisons of the biological activity of coal-derived materials. Methods will also be refined for the definition of a statistically significant positive response. Data derived from these studies will be of value in programs designed to identify and prioritize risks associated with coal use. The PDU-9 hexane fraction (organic solvent extract) is presently being analyzed chemically using HPLC and fluorescence techniques. Various fractions are being collected so as to identify and characterize the major peaks. These fractions will also be analyzed for their mutagenicities using the forward mutation assay. 2 figs., 2 tabs.

7882 (DOE/PC/70764—5-Pt.1) Effect of in-situ heat treatment on coal char reactivity. Final report, Part 1, March 15, 1984-March 14, 1986. Gangaram, G.; Essenhigh, R.H. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Nov 1986. Contract FG22-84PC70764. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87000956.

These results show that the effect of heat treatment appears to reduce char reactivity. The previous work showed that the rate of burn-out could be adequately predicted by the rate equation at the diffusion limit. The results of this work show that the diffusion limit would substantially overpredict the combustion efficiency in the early stages of the burn-out. Reasonable curve fitting between the model and experiments requires inclusion of a significant chemical kinetic component. Reduction of the average particle size from 70 microns to 50 microns would cause the diffusion limit to clearly overpredict the experimental burning times, and the Field data case to produce a good curve-fit of the experimental values. At the 10% excess air level, the burn-out times for 99% combustion efficiency show a burn-out time of 2500 milliseconds; this is an order of magnitude greater than for the same combustion efficiency and excess air obtained from the previous work on this furnace with no delay in secondary air supply. Excess air has approximately the same effect on burn-out times for both the diffusion controlled and the Field data case. Burn-out times for the Field data case are of the order of 0.3 to 1.0 second longer than the burn-out times for the diffusion controlled case, for corresponding excess air levels of 20 and 4%. At this time, it is the author's judgement that the data appear to support the hypothesis of rapid heat treatment in the flame with reduction of chemical activity on that account. 18 refs., 47 figs., 3 tabs.

7883 (DOE/PC/70764—6) Effect of in-situ heat treatment on char reactivity: Quarterly report for the period July 1986-September 1986. Basak, A.K.; Essenhigh, R.H. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Dec 1986. Contract FG22-84PC70764. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002949.

Work has been focussed on carrying out "hot" experiments to determine burnout times using Kentucky coal at different excess air levels, and determining backmixing characteristics using cold flow methods. The "hot" runs were made at 7% and 21% excess air levels. For the backmix experiments the technical approach used was to use helium as a tracer gas, inject it at some point in the furnace and follow its concentrations profile on either side of the injection point. Results of cold flow tracer experiments show that the backmix region's boundaries are 12 inches upstream and 2 inches downstream of the secondary air injection point for an air flow rate of 30 scfm. The Peclet number came out as 2.0. For a higher flow rate of 45 scfm, the backmix region increased in size with the upper boundary shifting another 9" and the lower one 2". The Peclet number decreased to 0.87. Results of the hot runs suggest that our flame program needs modification to account for the backmixing which changes the Particle Size Distribution. The calculated efficiency profiles underpredict the experimental results for 7% and 21% excess air levels in the fuel lean zone which extends from the secondary air injection plane to the end of the furnace. The reason appears to arise out of the effect of backmixing on the combustion efficiency due to excess air levels of 7% and 21%. For these excess air levels, it appears that significant backmixing extends up through the heat treating zone, resulting in significant char combustion before the secondary air injection plane. The flat temperature profile in this region is also indicative of the backmixing. In the present model char combustion is assumed to start at the secondary air injection level; this results in underprediction of the experimental results. The model is being upgraded to take into account the char reaction in the backmix region. 8 refs.

7884 (DOE/PC/70809—T11) Microbial screening test for lignite degradation. Quarterly progress report No. 7, July-September 1986. Yen, Teh Fu. (University of Southern California, Los Angeles (USA)). 1986. Contract FG22-84PC70809. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002297.

Biodegradation of water soluble fraction of modified lignite has been conducted. The biodegraded solutions were analyzed by ion chromatography (IC) in order to estimate the biodegradation efficiencies of bacterial species RC-W, RC-P and fungus RC-F which were isolated from oil-field soil. Nitration of lignite by nitronium salt solution is a promising method to incorporate nitrogen into lignite structures. Ultrasound was found to be useful to speed up nitration of lignite. Data obtained from IC and ultraviolet (uv) indicated the degradation of nitronium ion and the release of nitro compounds became faster as the reaction was carried out under sonic wave. It is believed the effect of sonic wave on the nitration of lignite resulted from (1) physical defoaming, (2) instability of interface between two phases, and (3) high temperature and high pressure induced by cavitation. A simple test designed for bioliquefaction study was attempted by using lignite with culture media and without culture media. Fungi grow on lignite with culture media and produce liquid drops. However, lignite without culture media gives negative results. A new method for enhancement of fungal growth has been developed. Fungal growth can be enhanced by using activated carbon as a support. 2 refs., 4 figs.

7885 **(DOE/PC/80911—T4) Linkages and aromatic clusters in a bituminous coal: Quarterly technical progress report No. 4, 06/01/86 through 08/31/86.** Chung, K.E. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). 1986. Contract FG22-85PC80911. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002475.

An Illinois No. 6 coal was solubilized in reactions with NaOH/ethanol/H_2O at 260, 300 and 320°C, which are called Ill-260, Ill-300 and Ill-320, respectively. In Ill-320, the conversion was 94%. The H/C ratio of the soluble product was increased to 1.07. CO_2 yield increased by more than three times that of Ill-300. This strong dependency of CO_2 evolution on temperature indicates that a unique hydrolysis reaction took place, which was not observed with low-rank coals. Comparison of yields and compositions of condensed-phase products from the three reactions revealed that hydrogen and oxygen were added to the coal by hydrolysis, and then carbon and oxygen were removed by decarboxylation. At 260°C, hydrolysis was the main reaction, while hydrolysis and decarboxylation were the major reactions at 300 and 320°C. The decarboxylation, however, was derived not directly from carboxylic acid or ester groups, but most likely from ketonized polycyclic phenols. Information on oxygen functional groups was combined with molecular structural data on aromatic clusters and aliphatic linkages to describe the molecular structure of the Illinois bituminous coal. Aromatic clusters are connected to others of similar cluster size by aliphatic linkages to make a group of aromatic clusters. Characterization data of the coal reveal that potential yield of distillable product from the hydroliquefaction is higher by 10 to 20% than recent yields obtained at the Wilsonville facility, although gaseous product yields agreed well. Predicted hydrogen consumption required to cleave aliphatic linkages in forming the distillable product is 0.4% of the feed, compared with total hydrogen consumption of 6.8% in the Wilsonville liquefaction process. This large difference indicates that a substantial improvement in the liquefaction technology is possible by reducing the hydrogen consumption. 3 refs., 4 figs., 3 tabs.

7886 **(PB—87-102158/XAB) Characterization of coal macerals by high-resolution supercritical fluid chromatography. Annual report, May 1985-April 1986.** Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). May 1986. 50p. NTIS, PC A03/MF A01.

Pyridine was selected as the solvent of choice for extraction of the soluble portion of coal. All extractions and subsequent treatments of the coal and coal extracts must be done under conditions that ensure that the samples are never exposed to temperatures above approximately 200°C. Treatments at higher temperatures have produced thermal degradation of the coal molecules. The volatile fraction of the pyridine extracts of two coals (PSOC-521 and PSOC-592) were fractionated into chemical classes and analyzed by capillary gas chromatography-mass spectrometry. Major compounds were identified as pentacyclic triterpanes, (hopanes and moretanes), alkylated 2- and 3-ring polycyclic aromatic compounds, and unsaturated pentacyclic triterpane derivatives. Five new compounds, never before reported, have been identified. A new UV-absorbance detector cell was constructed for evaluation of different supercritical mobile phases and mobile-phase additives. Preliminary experiments with supercritical ammonia indicate that this polar fluid may be useful for chromatography of coal molecules.

7887 **(STEV-TORV—86-14) Basic studies of waterbinding in peat. Report 1983-1986.** Albano, C.; Bohlin, E.; Berg, B. (Torvavvattningsprojektet, Umeaa (Sweden); Statens Energiverk, Stockholm (Sweden)). 1986. 227p. (TAP—1-86). NTIS (US Sales Only), PC A11/MF A01. File Number DE87750342.

The basic idea of the project has been to obtain as complete a description of peat as possible. More than 2000 peat samples have been collected, and among these about 100 have been subjected to extensive analysis. Biology: A microscopy method for botanical peat analysis has been adopted for routine description of the peat samples. Microbiological research has been started and the fungal flora of peatlands has been surveyed. Chemistry: A set of traditional and widely used basic peat analysis has been established. Comprehensive analysis of organic components in peat was started. Fraction procedures have been replaced by a new approach. This has so far been successfully applied to carbohydrate and amino acid analysis. In order to describe the complex peat structure in objective terms, computerized image analysis has been applied. Physical methods: Peat-water relationships have been studied by means of traditional soil science methods. Thermogravimetry has been used of the same purpose as well as for general characterization of peat. Nuclear Magnetic Resonance-, Electron Spin Resonance-, Infrared- and Ultraviolette-spectroscopy have been used, both for characterization of peat in general terms and for studies of waterbinding forces. NIR-spectroscopy in combination with multivariate data analysis has been successfully used to predict a range of chemical, physical and botanical properties of peat samples. Dewatering: Methods for mechanical and thermal dewatering have been established in laboratory-scale. Surface chemistry methods and principles have been used in a comprehensive study of factors that influence the process of mechanical dewatering. System analysis: Multivariate data analysis (principal component analysis and partial least squares) have been applied to extract systematic and relevant information from data measured on peat.

0108 Waste Management

REFER ALSO TO CITATION(S) 7912, 8152, 8154, 8157, 8158

7888 **(DOE/PC/80515—4) [Surface science model studies for flue gas cleanup process on CuO and Fe_2O_3]: Technical progress report, June 1986-August 1986.** (Maine Univ., Orono (USA)). 1986. Contract FG22-85PC80515. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002449.

During the reporting period we expanded our study of the adsorption of SO_2, by studying its interaction with clean CuO and Cu_2O surfaces. These two surfaces are chemically different as shown by x-ray photoelectron spectroscopy (XPS). Surface preparation and cleaning are difficult, because in most cases the entire oxide layer must be removed between experiments and then the clean copper is reacted with oxygen to produce the desired substrate. SO_2 was exposed to each substrate at 173K, 300K, 473K, and 673K. Following 1200 L SO_2 exposure the sample was heated and the changes in the surface region were recorded. The major change in the surface region is segregation of sulfur to the surface at temperatures between 100° and 400°C. Coadsorption studies of O_2 and SO_2 on various copper substrates have begun. 3 figs.

7889 **(IS-M—597) Stabilization of coal cleaning waste by a granulation/sintering process.** Gokhale, A.J.; Burnet, G. (Ames Lab., IA (USA)). 1986. Contract W-7405-ENG-82. 27p. (CONF-860826—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002730.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Coal cleaning wastes are ground, granulated and sintered to form vitreous, impervious pellets capable of disposal without dusting, leaching or smoldering. The process utilizes the energy inher-

ently present in the wastes. Fly ash and flue gas desulfurization sludge can be blended with the cleaning wastes for codisposal. Characterization and grinding of the wastes, the formation and testing of green granules for strength and durability, the design and operation of a fixed bed, batch sintering furnace, and preliminary evaluation of the sintered granules are discussed.

7890 **(PB—87-101770/XAB) Boiler-simulator studies on sorbent utilization for SO_2 control. Final report, March-September 1984.** Overmoe, B.J.; Ho, L.; Chen, S.L.; Seeker, W.R.; Pershing, D.W. (Energy and Environmental Research Corp., Irvine, CA (USA)). Sep 1986. 167p. NTIS, PC A08/MF A01.

The report gives results of a program to provide process design information for sorbent utilization as applied to EPA's LIMB process. Specifically, the program was designed to investigate the role of boiler thermal history, sorbent injection location, Ca/S molar ratio, and SO_2 partial pressure on capture effectiveness with limestones, dolomites, and slaked limes with and without metallic promoters. The experimental studies were supported by theoretical calculations using grain and pore models that considered both the heterogeneous chemical reaction and the relevant diffusional processes. The experimental results and the sulfation model calculations indicate that the sorbent injection locations and the residence time within the sulfation temperature window can significantly influence overall sulfur capture for any sorbent. Unless the sorbent is promoted with a metal additive, downstream injection at about 1500 K results in optimum sorbent utilization.

7891 **Short and long-term leaching behavior of a low-calcium fly ash and cement-stabilized fly ash.** Malek, R.I.A.; Licastro, P.H.; Roy, D.M. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 269-284 of Fly ash and coal conversion by-products: Characterization, utilization and disposal II. McCarthy, G.J.; Glasser, F.P.; Roy, D.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-851217—).

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Low-calcium fly ashes from eastern Pennsylvania power plants, stabilized with Portland cement, have a potential application as a pipeline bedding material. A typical fly ash, and a cement-stabilized material made with this fly ash, were subjected to extensive physical and chemical characterization. Two procedures were used to investigate whether leachates from the bedding materials were nonhazardous according to the criteria of the regulatory agencies. The first was the short-term EPA test, used to define a hazardous waste under the RCRA regulations, and the second was a long-term flow-through test developed at MRL/PSU. In the second test, driving pressure, flow rate and permeability were monitored during the experiment. Calculations showed that this flow-through technique simulates rain water percolation in a similar sized bed for about 25 years. The leaching fluids in both methods were deionized water (EPA procedure) and simulated rain water. Analyses for seventeen metals by DC plasma emission spectrometry and for seven anions by ion chromatography were performed. Concentrations of the leachates from the two procedures were well below the levels that define a hazardous waste. Considerable insight into the long term leaching mechanisms of various elements was obtained from the flow-through experiments.

7892 **Modeling of fly ash concrete mixtures.** White, E.L.; Roy, D.M. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 243-254 of Fly ash and coal conversion by-products: Characterization, utilization and disposal II. McCarthy, G.J.; Glasser, F.P.; Roy, D.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-851217—).

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

A Factor Analysis Model was applied to existing literature data on fly ash and cement properties to relate them to the strength and durability of the cured pozzolanic concrete products. A normal curve was fitted to each independent fly ash and cement property and to each dependent strength property. Functions of the moments, such as indicators of skewness and kurtosis of each property, were calculated and the significance of their departures from the expected values of a normal population was examined. About one-half of the properties were log-normally distributed; the remainder were normally distributed as given. A predictive model was proposed for compressive strength, using the percent sulfate as representative of Factor I, the cement quantity as representative of Factor II, and the percent Fe/sub 2/O/sub 3/ as representative of Factor III.

7893 **Trapping of chloride ions in cement pastes containing fly ash.** Roy, D.M.; Malek, R.I.A.; Rattanussorn, M.; Grutzeck, M.W. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 219-226 of Fly ash and coal conversion by-products: Characterization, utilization and disposal II. McCarthy, G.J.; Glasser, F.P.; Roy, D.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-851217—).

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Chloride ions, when present at sufficient concentration in the concrete pore fluid, may be associated with corrosion of the reinforcing steel even in normally passivative environments. The effectiveness of fly ash containing pastes in trapping chloride ions was studied. A paste was prepared containing 30% low-calcium fly ash and 70% type I cement, with mixing water (50% by weight) containing 0.4% Cl/sup -/ with respect to the solid. Samples were cured at 25°C and 38°C at 95% R.H. At designated times extending over a six-month period, the pore fluids were expressed from the hardened pastes using a squeezing cell designed for this purpose. Special precautions were taken to avoid carbonation of the fluids; contact with the atmosphere was minimized. The expressed fluids were analyzed by DC plasma emission spectrometry for cations and by automated selective ion exchange chromatography for anions. Other studies (XRD, thermal analysis) were carried out to identify the compounds formed and determine their mechanisms of formation. Investigations indicated that the mechanism of trapping chloride ion is partly chemical and partly physical through adsorption on the surface of fly ash particles (initially physical and subsequently chemical).

7894 **Diffusion and pore structure in Portland cement pastes blended with low calcium fly ash.** Kumar, A.; Roy, D.M. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 227-234 of Fly ash and coal conversion by-products: Characterization, utilization and disposal II. McCarthy, G.J.; Glasser, F.P.; Roy, D.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-851217—).

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Effective coefficients for the diffusion of Cs/sup +/ and Cl/sup -/ ions across hardened plates of Portland cement and Portland cement-fly ash blend pastes were measured at 27°, 38° and 60° for samples cured up to 28 d. The porosity and pore size distributions of the same hardened plates were also determined. The fly ash blends show lower anion and cation diffusion rates at higher temperatures, although the porosity is not significantly different from the neat paste. The finer pore size is considered responsible for the slower diffusion in the blends. The electronegative nature of the pore surfaces also contributes to the slower cation diffusion.

7895 **A survey of ash sources for mineral recovery.** Watson, J.S. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 59-70 of Fly ash and coal conversion by-products: Characterization, utilization and disposal II. McCarthy, G.J.; Glasser, F.P.; Roy, D.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-851217—). Contract AC05-84OR21400.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Twenty-two ash samples from utility companies across the country were studied to determine their potential use for mineral recovery. Most tests were limited to chemical analyses and determination of leachable metal values in the ashes, but samples from two utilities were examined in more detail. The more detailed analyses included physical as well as chemical properties. This work was part of a broad-based effort supported by the Electric Power Re-

search Institute (EPRI), and the results from this study were used in economic assessments of mineral recovery from fly ash made by engineers in another part of the EPRI program. Although the compositions and properties of the ash samples varied considerably, only two of the 22 ash samples studied appeared to be unsuitable for mineral recovery. These results indicate that large portions of the ash produced in this country are suitable for potential resource recovery, but further work to evaluate potential upgrade of the leached ash residue is recommended.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 7891, 8153

7896 **(DOE/FE/55014—T25) [Great Plains coal gasification project]: Quarterly environmental report, Third quarter 1986.** (ANG Coal Gasification Co., Beulah, ND (USA)). Oct 1986. Contract FM02-82FE55014. 289p. NTIS, PC A13. File Number DE87002463.

Environmental monitoring, supplemental environmental programs and quality assurance/quality control activities are presented in this quarterly report. Under the environmental monitoring program, the following topics are covered: permitting activities; ambient monitoring; plant discharge monitoring; pollution control unit emissions; surface mining and reclamation; environmental incident summary; and regulatory environmental inspections. The supplemental environmental program covers: performance survey; toxicity screening study; data base management system; epidemiology; and contingency program. 16 figs., 53 tabs. (AT)

7897 **(ECN—86-142) Below and in cloud scavenging of particulates and gases.** Ten Brink, H.M.; Janssen, A.J.; Voors, P.J.; Slanina, J. (Netherlands Energy Research Foundation, Petten). Oct 1986. 14p. (CONF-8609195—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 4. European symposium on the physico-chemical behaviour of atmospheric pollutants; Stressa, Italy (23 Sep 1986).

The below-cloud scavenging of pollutants in the plume of a coal-fired power plant has been measured. The higher than expected scavenging rate for particulates is attributed to growth of the particles by water accretion in the wet plume. The two-fold increase in the acid deposition in the near vicinity of the installation is associated with and predominantly caused by the wash-out of hydrogen chloride from the the plume. The almost negligible and erratic scavenging of sulfur dioxide in plumes is explained in a quantitative sense by detailed plume wash-out calculations. As a first estimate it is calculated that below-cloud scavenging contributes about one third to the total wet deposition of acid related compounds in the Netherlands. Highly efficient in-cloud scavenging of sulfate and submicron aerosol mass was recorded in aircraft flights. 5 figs., 2 tabs., 17 refs.

0110 Reserves And Exploration

7898 **(ARC-ESR—85-1) Coal rank and rank variation within Upper Cretaceous and Tertiary sediments, Alberta plains region.** Nurkowski, J.R. (Alberta Research Council, Edmonton (Canada)). 1985. 43p. Alberta Research Council, Edmonton, Canada.

An analysis of near surface coal reserves of the Alberta plains was undertaken to determine both the distribution of, and the interrelationships between, the components of proximate and ultimate analysis and calorific value determinations. The coals range in rank from subbituminous C to high volatile bituminous C. They increase in rank towards the west-southwest, i.e. towards the mountain/foothills region. A new model is proposed which will explain coal rank variation in this area. (38 refs.)

0120 Mining

REFER ALSO TO CITATION(S) 7870, 7916, 7919

7899 **(DOE/PC/91271—T2) Coal disintegration by high pressure water jet: Technical progress report No. 2, October 20-November 20, 1986.** Mazurkiewicz, M. (Missouri Univ., Rolla (USA). Rock Mechanics and Explosives Research Center). 1986. Contract AC22-86PC91271. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002461.

All pressure inside crack measurement was conducted for nozzle diameter d = 0.041 and 0.062 of inch with the pressure P_1 = 5000 psi and standoff distance L = 0. The crack model was moved with respect to the stable nozzle along the crack and perpendicular to the crack as shown on Fig. 1. The model was displaced from left to the right position (-4d to +4d) in 50 seconds and the pressure before the injecting nozzle (gage a) and pressure inside the crack (gage b) was recorded and plotted by computer. The position of the gage b was changed during the study.

7900 **(PB—87-101846/XAB) Effects of millisecond-delay intervals on vibration and airblast from surface-coal-mine blasting. Report of Investigations/1986.** Kopp, J.W.; Siskind, D.E. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1986. 51p. (BUMINES-RI—9026). NTIS, PC A04/MF A01.

Library of Congress catalog card no. 86-600038.

A major concern with blasting at surface mines is generation of ground vibrations and airblast and their effects on nearby residences. This report looks at the use of millisecond delays in blast design and their effect on the resulting ground vibrations and airblast. A total of 52 production blasts were instrumented and monitored at a surface coal mine in southern Indiana.

7901 **(SAND—86-0424C) Safety evaluation of coal mine power systems.** Collins, E.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 45p. (CONF-870104—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013577.

From Annual reliability and maintainability symposium; Philadelphia, PA, USA (27 Jan 1987).

This paper documents the development and application of an analytical technique that identifies potential electrical hazards in existing coal mine power systems. Specifically, a safety evaluation technique is developed by integrating preliminary hazard analysis; operating hazard analysis; failure mode, effect and criticality analysis; fault tree analysis; and accident report analysis. This technique assists the analyst in identifying potential hazards in a system initiated by component failure and/or human error, qualitatively ranks the hazards based on accident data, and provides a valuable tool in evaluating design and/or procedural methods (countermeasures) to control or mitigate the effects of the hazards. Application of this technique to a representative model of a coal mine distribution power system identified six countermeasures that control or mitigate the effects of a majority of the electrical accidents used in the analysis. Also, the results indicated that human error and poor design of maintenance features of the equipment directly contributed more to accidents than component failures. However, component failures do result in increased exposure of maintenance personnel to electrical hazards present in the system. Safety design criteria for the electrical system consisting of 37 recommendations based on fault trees developed in the evaluation process and a literature review are defined. These criteria are basic guidelines for designers, manufacturers, and operators of coal mine power equipment to employ to minimize electrical hazards inherent in the mine power system. 13 refs., 7 figs., 8 tabs.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 8446

7902 **(ANL/FE—84-20) System description of the ANL [Argonne National Laboratory] Slurry Loop Testing facility (SLTF).** Porges, K.G.; Cox, S.A.; Brewer, W.E.; Hacker, D.S. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31-109-ENG-38. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002848.

This report describes a test loop specifically designed for dense slurries. The loop provides flow velocity and medium composition calibrations within 1%, as well as online rheometric characterization in non-Newtonian, laminar flow, by means of several unique calibration facilities developed at Argonne National Laboratory. Two horizontal test sections of 6 and 12 m length, as well as a vertical test section of 6 m length, are provided for flowmeter calibration; up to 5 flowmeters can be accommodated simultaneously. In addition to the online calibration schemes, which rank this test loop among the most accurate facilities currently existing, extensive laboratory characterization of grab samples is available. Initial work with coal/oil and coal/water slurries ranged over 60% solids. 18 refs., 26 figs., 1 tab.

7903 **(DOE/PC/70803—T8) Model for the flow of particulate material with application to chutes. Final report.** Jackson, R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1986. Contract FG22-84PC70803. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001943.

This two year investigation was initiated with the goals of identifying the relevant momentum and energy transport mechanisms within a flowing particulate material, formulating equations of motion based on the transport mechanisms, and then generating solutions for some simple flows for which experimental data is either available or easily measured. Several of the goals that were proposed at the beginning of the study have been reached. A theoretical description of cohesionless granular flows has been constructed from sound physical principles, plausible assumptions, and existing constitutive laws. The governing equations which include both collisional and frictional stresses, are dependent only on physical properties of the material that can, in principle, be determined by independent experiments. The solutions qualitatively predict observations from shear cell tests, and more importantly, reveal the importance of detailed descriptions of the experimental procedure. Inclined flow solutions seem to predict the behavior that might be expected, but they still need to be compared with observations that will be obtained from the inclined chute flow loop. 17 refs., 8 figs., 1 tab.

7904 **(DOE/PC/80524—T5) Pipe and bend erosion by pneumatic transport of solids at high temperatures: Quarterly report, June-August 1986.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1986. Contract FG22-85PC80524. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002933.

During this period four new experiments have been completed. In these experiments the gas velocity and the solid load have been varied. In addition to the erosion data, the pressure drop at high temperature has been investigated. The effect of gas velocity and solids flow rate is discussed. 2 figs., 3 tabs.

0140 Combustion

REFER ALSO TO CITATION(S) 7902, 8265, 8305, 8316

7905 **(ANL/CNSV—55) Computer simulation of furnace heat transfer for coal combustion in CO_2/O_2 atmospheres.** Berry, G.; Reddy, N.; Wolsky, A. (Argonne National Lab., IL (USA)). Jun 1986. Contract W-31-109-ENG-38. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002849.

This report presents the results of computer modeling conducted by Argonne National Laboratory (ANL) to simulate the heat transfer that results from burning coal in a mixture of CO_2 and O_2 rather than in air. A one-dimensional model was developed and used to simulate results for a coal-air burn and for burns using three different CO_2-to-O_2 ratios: 3.65:1, 2.42:1, and 2.23:1. These simulation results are compared with experimental results for the same four cases. We find that the ANL model effectively predicts heat transfer in a coal-air burn and in the three CO_2/O_2 burns. Both the model predictions and the test observations also demonstrate that using a CO_2/O_2 mixture, in a ratio between 2.42:1 and 2.23:1, as the oxidizer imitates the heat-transfer results of a conventional coal-air burn. These findings lend further credence to the feasibility of burning coal in CO_2/O_2 rather than air, a new concept being investigated by ANL. One principal motivation for the investigation is to find a way of suppressing harmful combustion effluents. Another is to determine the feasibility of recycling part of the combustion products (CO_2, principally) back to the combustion process and also of recovering saleable CO_2. 11 refs., 9 figs., 5 tabs.

7906 **(CONF-861146—8) Measurement of turbulent stresses in a gas-solid fluidized bed.** Moslemian, D.; Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1986. Contract FG22-85PC80511. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87000864.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Turbulent stresses experienced by particulate phase in a gas-fluidized bed are evaluated from measured instantaneous velocities of solids using a particle tracking facility. Glass beads ranging from 425 to 600 μm and from 625 to 800 μm and superficial gas velocities of 2.5, 4.5, and 6.0 times the minimum fluidization velocities were used. In this particle tracking facility, the gamma radiation emitted from a radioactive tracer particle, which is dynamically identical to the bed particles and is mixed into the bed, is continuously monitored by a large number of scintillation detectors to provide direct experimental determination of both time-averaged and the fluctuating solids velocities as well as the particulate phase density. The turbulent shear stress is obtained from the cross correlations of solids fluctuating velocities. The turbulent normal stresses are determined from the Lagrangian velocity autocorrelations. Such information is useful in the formulation of momentum conservation equations and the development of realistic hydrodynamic models for gas solid fluidized beds, which in turn are essential for developing scale-up relations. 15 refs., 16 figs.

7907 **(DOE/FE/60181—2126) Fundamental combustion and ash fouling: Final report for the period ending June 30, 1986.** Young, B.C.; Miller, B.G.; McColler, D.P.; Schnabel, K.D.; Kleesattel, D.R.; Jones, M.L. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Sep 1986. Contract FC21-83FE60181. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001014.

Combustion rate data were determined from the measurements of particle temperatures of chars derived from three low-rank coals. The measured particle temperatures of the chars substantially exceed the ambient gas temperature. At an oxygen mole fraction less than 0.12, it was found that the burning rates of the low-rank coal chars were greater than the calculated diffusion-limited rates based on conversion of carbon to carbon monoxide. The reactivity of the chars was reduced with the removal of mineral matter although the burning rate was insensitive to differences in physical structure. The results were consistent with diffusion-limited rate control and the extreme reactivity was rationalized by assuming that carbon dioxide, along with carbon monoxide, is formed as a primary product. It is suggested that the presence of mineral matter in the low-rank coal chars gives rise to formation of carbon dioxide at the surface. Model calculations were undertaken and they satisfactorily explain the results. A preliminary study to determine the feasibility of Raman spectroscopy as a means of studying surface chemistry of high-temperature ash material has been completed. Raman spectroscopy provides information which is similar to conventional techniques such as microscopy and x-ray diffraction. However, since Raman spectroscopy is a non-intrusive optical scattering technique, it allows the study in situ of hot ash deposits as they are formed. Combustion tests were performed on the ash fouling test combustor. Differences were noted in the rate of deposition, strength of deposits, and composition of deposits produced

from a standard utility grind (70% < 74μm) and a micronized grind (100% < 15μm). 57 refs., 31 figs., 46 tabs.

7908 **(DOE/FE/60181—2127) Fluidized bed combustion of low-rank coals: Final report for the period ending June 30, 1986.** Mann, M.D.; Hajicek, D.R; Zobeck, B.J.; Kalmanovitch, D.P.; Bobman, M.H.; Kadrmas, R.J.; Grewal, N.S. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Sep 1986. Contract FC21-83FE60181. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001015.

Specific goals included the development of a data base on AFBC processes and systems utilizing low-rank coals, including corrosion and erosion of heat transfer surfaces, gaseous and particulate emissions, in-bed and freeboard heat transfer, and waste characterization. Three 1000-hour tests were performed, using South Hallsville, Texas lignite A, Sarpy Creek (Absaloka), Montana subbituminous B, and Navajo, New Mexico subbituminous A as fuels. Greater tube deposition and under-deposit corrosion were noted for the highly alkaline ash of the Sarpy Creek coal, while the more acidic ash from the other two coals appeared to be more erosive. With the exception of carbon steel, no major differences were noted among the different metallurgies studied. Other results indicate that high retention of sulfur in the bed can be obtained for coals with a highly alkaline ash, such as Sarpy Creek, while only a minimal amount is retained by the low-rank coals with acidic ashes. High combustion efficiencies, greater than 98%, can be expected for all coals tested even without ash recycle. Agglomeration was observed during tests using both silica sand and limestone as bed material and was a strong function of the level of sodium in the coal ash. Work was performed to develop and refine predictive equations for estimating heat transfer coefficients, based on the data collected during normal operation. Special testing was also performed to determine the emissivity of bed materials and the radiative contribution to heat transfer. The size of the bed particles was found to have the most dominant effect on heat transfer, with a 50% reduction in the heat transfer coefficient noted with increases in the particle diameter from 0.544 to 2.335 mm. Correlations were found to predict the coefficient to within 20%. 77 refs., 77 figs., 35 tabs.

7909 **(DOE/PC/70764—T7) Effect of in-situ heat treatment on coal char reactivity. Technical report.** Essenhigh, R.H. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Nov 1986. Contract FG22-84PC70764. 16p. NTIS, PC A02. File Number DE87002263.

The objective is to determine whether milli-second in-situ heat treatment of coal char reduces its reactivity. To date, we have burned over 3500 pounds of bituminous coal, and established two complete profiles at 4% and 8% excess air levels. At the 4% excess air level, a significant kinetic component was required to match the model to the experimental profiles, indicating reduction in char reactivity due to heat treatment. However, at the 8% excess air level, char reactivity was significant in the heat treating zone indicating significant backmixing of the secondary air into the region upstream of the secondary air injection level. Work on characterizing char behavior in the backmix region has focussed on determining the particle size distribution (PSD) and the backmix profiles in this region. Helium tracer tests (cold) have been carried out and the boundaries of the backmix region have been identified. A mathematical model to predict the PSD in the backmix region has been developed. 9 figs.

7910 **(DOE/PC/80529—T3) Effects of coal structure on pulverized coal combustion processes. Quarterly technical progress report No. 4, July 1-September 30, 1986.** Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Oct 1986. Contract FG22-85PC80529. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001777.

The general objective of this study is to define and quantify the relationships between coal composition and structure and associated combustion and conversion behavior for three very different domestic coals. To accomplish this objective, two tasks have been identified. The first is to characterize the virgin coal and their prepared chars. The second task is to measure high temperature reaction rates of the virgin coals and their derived chars, and to interpret results in light of Task 1. Results will give the necessary information to determine if the char reaction rates are dependent on coal physical and chemical characteristics. During this past quarter, a method for reducing agglomeration in the -325 +400 mesh fraction of the Utah bituminous coal has been identified. Elemental analysis has been completed for the two size-graded fractions of the coals. A program for measurement of active surface area of coals and chars has been initiated in cooperation with the BYU Catalysis Laboratory. Equipment has been received for the calibration of reactor optics. The data acquisition system design has been completed. 12 refs., 1 fig., 1 tab.

7911 **(ECN—86-105) Characterization of coal combustion residues.** Vleeskens, J.M.; Malechaux, L. (Netherlands Energy Research Foundation, Petten; Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR), Verneuil-en-Halatte). Jul 1986. 24p. (CONF-8609194—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From ICCP working group combustion meeting; Doncaster, UK (8 Sep 1986).

A condensed overview of existing methods for characterization of organic residues from coal combustion is given. Char characterization is being performed using different optical techniques and more or less refined schemes for identification of the residual particles. Depending on the nature of the problem, one type of analysis may be preferred over another. Unification of method should, however, be pursued where practicable. 5 figs., 3 tabs., 14 refs.

7912 **(IVO-B—05/86) Ways of utilizing ash-desulphurization mixtures produced during lime injection in fluidized bed boilers and pulverized fuel boilers.** Salo-Asikainen, S. (Imatran Voima Oy, Helsinki (Finland)). Jun 1986. 39p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750390.

When flue gases are desulphurized e.g., by injecting limestone powder into a pulverized fuel boiler or a fluidized bed boiler, the end product is a mixture of ash and calcic substances, which can be used in principle as an additive in mortar, concrete, cement and bituminous building materials. Ash can probably also be used for landfilling and fertilization of woodland. Most ways of utilization are only being developed under laboratory conditions, but as far as we know the ash recovered from the fluidized bed containing calcic compounds has also been used commercially as a additive in mortar in the Federal Republic of Germany. The utilization of the ash recovered from the fluidized bed in the building materials industry is mainly based on its pozzuolanic properties, i.e., the capability to harden like cement. The pozzuolanic properties of this ash have not yet been found out for sure, however. The free CaO and SO_3 also restrict the use of the ash recovered from the fluidized bed in the building materials industry. The ash recovered from the lime injection technique differs from the ash recovered from the fluidized bed particularly with regard to the great amount of inert CaO. The report is primarily based on the situation in the Federal Republic of Germany.

7913 **(STEV-FBA—86-5) Qualitative comparison of calculated and measured profiles of temperature in a pulverized coal flame.** Bergdahl, B.G.; Gromulski, J. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 13 Mar 1985. 42p. (In Swedish). (STUDSVIK-EB—85-18; STUDSVIK-NR—85-34). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750359.

A mathematical model of a pulverized coal flame is presented. The calculations are based on the total area of all particles in a volumetric unit. All particles are assumed to have the same size. The combustion is divided in two phases. The volatile parts of the fuel are burned in the first phase and the solid parts in the second phase. (K.A.E.).

7914 **(STEV-FBA—86-6) Combustion of coal in thermogravimeter and crop tube furnace.** Bengtsson, M.; Espenaes, B.G.; Gromulski, J. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 7 Jun 1985. 81p. (In Swedish). (STUDSVIK-EB—85-46). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750358.

The report presents the results of tests of six different coals. The results of the thermal gravimetric analysis are compared with the tests in the drop tube furnace. (K.A.E.).

7915 **(TKK-KO/ET—12) Application of fluidized-bed combustion on small heating boilers.** Jahkola, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1985. 164p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87750398.

Research and development work, which aimes at developing an easy-operating, far automatized and environment saving small fluidized-bed heating boiler for different kind of solid fuels, has been carried out at Helsinki University of Technology since 1981. Within the project two laboratory boilers with outputs of 25 kW (1981) and 300 kW) (1983) as well as three small house boilers of 10 kW (1982-1983) have been built. In this report the structures of the built 10 kW small-house boilers of the 300 kW laboratory boiler are described as well as the experiences got of the boilers during 1983-1985 and the results of laboratory tests with various fuels are presented. According to the experiences the efficiency and the applicability to various fuels have been good and load control region wide. Utilizing the experiences and research results obtained during the study the thermal dimensioning, the automatic control, the start-up system and the flue-gas cleaning equipments for the boilers have been developed and technically satisfactory solutions have been achieved. In the light of achieved research results the commercial prerequisites for application of fluidized-bed combustion on small heating boilers have been examined in the report, too. In the small-house scale competitiveness has been regarded as too small. In the blockhouse scale (100...1000 kW) chances for realizing a commercially competitive product are essentially better. Therefore a possible concept for a factory-made fluidized-bed heating plant in the blockhouse scale is presented at the end of the report.

0150 Marketing And Economics

7916 **(DOE/EIA—0118(85)) Coal production 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 7 Nov 1986. 132p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87002457.

Coal Production 1985 provides comprehensive information about US coal production, the number of mines, prices, productivity, employment, productive capacity, reserves, and stocks to a wide audience including Congress, Federal and State agencies, the coal industry, and the general public. All data presented in this report, except the total production table presented in the Highlights section, and the demonstrated reserve basc data presented in Appendix A, were obtained from form EIA-7A, "Coal Production Report," from companies owning mining operations that produced, processed, or prepared 10,000 or more short tons of coal in 1985. The data cover 4105 of the 5477 US coal mining operations active in 1985. These mining operations accounted for 99.4% of total US coal production and represented 74.9% of all US coal mining operations in 1985. This report also includes data for the demonstrated reserve vase of coal in the US on January 1, 1985.

0160 Health And Safety

REFER ALSO TO CITATION(S) 7881, 7901

7917 **(LA—10800-MS) Industrial Hygiene Group 1985 annual research report.** Ettinger, H.J. (ed.). (Los Alamos National Lab., NM (USA)). Aug 1986. Contract W-7405-ENG-36. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002242.

Studies relating to the performance of respiratory protective equipment have (1) developed new automated fit test methods, (2) determined the performance of respirators under temperature and humidity extremes, (3) assisted in evaluating the performance characteristics of a new military mask being developed, (4) evaluated alternate nondestructive respirator fit test methods, and (5) examined the performance of sorbents. Investigations of the use of personal protective clothing (PPC) have identified potential alternate field test methods and evaluated a potential simple screening test to be used as a PPC selection guide. Aerosol research has (1) evaluated instrumentation characteristics relative to respirator fit testing, (2) developed special aerosols for inhalation toxicology studies involving fibers and highly toxic chemical agents, and (3) defined the relative efficiency of alternate field-sampling cassette designs used for industrial hygiene personal sampling. Air-cleaning studies have resulted in the development of new filter test methods for respirator and space filters and evaluated the feasibility of a filtration system using liquid barriers. Applied industrial hygiene studies have evaluated the health hazards at a coal gasification facility, investigated the testing and use of chemical fume hoods, helped evaluate special DOE industrial hygiene concerns, and examined uranium solubility.

7918 **(ORNL/TM—10204) Physical and chemical characterization of SRC [solvent refined coal] Toxicology Program samples.** Griest, W.H.; Ma, C.Y.; Rubin, I.B.; Tomkins, B.A. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002977.

The components traditionally thought to contribute to the tumorigenic response of the SRC-I Solid in the inhalation bioassay are PAH which are found at concentrations up to 280 μg/g each. These compounds are readily leached from the solid and can accumulate in phospholipid vesicles at μg/g concentrations. The greater skin irritation caused by the TSL Middle Distillate versus the SRC Middle Distillate does not appear to be associated with their content of phenol and C_1- or C_2-phenols. Other compounds, such as hydroaromatics, may be responsible for the irritation. 28 refs., 4 figs., 9 tabs.

7919 **(PB—87-103271/XAB) Development of a fire-evaluation system for underground coal mines.** Shibe, J.A. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Aug 1986. 146p. (NBSIR—86/3425). NTIS, PC A07/MF A01.

A prototype Fire Safety Evaluation System was developed and is ready to be evaluated by a Peer Consulting Panel and for performing field tests. The system can be used to determine combinations widely accepted as fire safety equipment and underground coal mines features that provide a level of safety equivalent to those required by the Code of Federal Regulations-Title 30 for underground coal mines. In this evaluation, equivalent safety performance is gauged in terms of overall level of safety provided rather than by a component-by-component comparison.

02 PETROLEUM

0202 Geology And Exploration

7920 **(IKU-R—01.0244.00/01/86) Electromagnetic logging. Mathemathical models.** Raaen, A.M.; Fjaer, E.; Kristensen, A. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Feb 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750374.

Three different mathematical models for multicoil induction logging tools are discussed. All models assume cylindrical symmetry. The models are: (1) Geometrical factor model. This model is valid for low frequencies and low conductivities. The formation may be both radially and vertically layered. (2) Full wave solution, radially layered formation. (3) Full wave solution, vertically layered formation. Examples of results from computer implementation of the models are given. 14 references.

7921 **(RISO-M—2552) Preliminary simulations of transformation ratios for the Danish well AARS - 1A.** Jensen, P.K. (Risoe National Lab., Roskilde (Denmark)). Jan 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750336.

A computer code used to simulate the history of burial, temperature and vitrinite reflectance has been extended to include a model for calculation of transformation ratio based on Tissot and Espitalies chemical model for degradation of kerogen as parallel first-order reactions. Calculations of transformation ratios for the well AARS - 1A is presented. The values are unfortunately much too high compared with vitrinite reflectance measurements, assuming the most realistic heat flow history. It is concluded that the constants determining the degradation of the kerogen must be calibrated. Parameter studies show that compaction of the sediments and a reliable surface temperature history must be considered to obtain a reliable history of the formation temperatures. EFP-85. 14 refs.

0203 Drilling And Production

7922 **(ANL/CNSV—56) Carbon dioxide required for enhanced oil recovery in the Ohio Valley Region and potential oil production from such recovery.** Walbridge, E.W.; Wolsky, A.M. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31-109-ENG-38. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002992.

The total quantity of carbon dioxide that will be required for enhanced oil recovery (EOR) in the Ohio Valley Region is estimated, as is the quantity of oil that can be recovered. Screening criteria are used to select reservoirs amenable to miscible- or immiscible-CO_2 flooding. Five reservoirs are assigned to miscible-CO_2 EOR and one to immiscible-CO_2 EOR. If conventional EOR technology, a 10% rate of return, nominal oil prices of $30 and $40/bbl, and CO_2 costs in the range of $0.50-3.00/10^3$ scf are assumed, these six reservoirs would yield at most 78×10^6 bbl of oil; this yield would result from flooding with 389×10^9 scf of purchased CO_2. Virtually all the oil would come from five reservoirs in Illinois (the sixth reservoir is in Ohio). The required CO_2 could be provided by recovering the CO_2 generated at one coal-fired plant during the production of approximately 2400 MW-yr of electricity (e.g., a 100-MW unit operating for 24 yr at 100% capacity). If SO/sub x/ recovery is concomitant with CO_2 recovery (as it is in a recovery method that Argonne National Laboratory is investigating) and if acid-rain legislation mandates reduced emissions, an electric utility may find it economical to recover CO_2 and avoid scrubbing costs at a generating unit that is near an oil reservoir. Potential plant units that could use this approach are identified. 8 refs., 16 figs., 6 tabs.

7923 **(IKU-R—08.2600.00/01/85) Miscible displacement. Yearly report 1984.** Glasoe, O.; Hagen, A.; Hveding, N. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Jan 1985. 139p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750378.

In the Norwegian sector of the North Sea, gas is today injected back into the reservoirs, primarily for temporary storage of gas until pipelines to the gas markets are ready. In addition, the possibility of enhanced oil recovery as a result of gas injection, has created an increasing interest in miscibility studies of gas and oil from the North Sea reservoirs. Results from high pressure slim tube displacement tests with two gas-oil hydrocarbon systems are presented. The objective of these tests is to determine the minimum miscibility pressures (MMP), and to examine the mechanisms operating in multicontact miscible flooding. Predicted MMP's from calculated gas-liquid equilibrium data are compared with MMP's determined from slim tube displacement tests of the same gas-oil hydrocarbon systems. Results from phase behavior studies and simulation tests with two and three component systems are also given. 13 references.

7924 **(IKU-R—08.2600.03/04/86) Effect of aqueous phase on minimum miscibility pressure.** Glasoe, Oe. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Feb 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750373.

High pressure slim tube displacement tests with oil from the Ekofisk field in the North Sea, and nitrogen, have been performed. Results from this study show that the effect of the aqueous phase on the minimum miscibility pressure (MMP) with nitrogen at 140 deg. F is very small. An examination of the effect of temperature on oil recovery from miscible displacement tests with a 100% oil saturated slim tube, showed that the oil recovery was lower at a temperature of 140 deg. F. The effect of aqueous phase on MMP with nitrogen at temperatures other than 140 deg. F has not been tested. 10 references.

7925 **(IKU-R—08.2610.00/01/85) Experimental and numerical simulation studies of miscible displacement.** Hagen, S.; Kossack, C.A. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Mar 1985. 135p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750376.

Using simple two- and three-component hydrocarbon mixtures, the ability is evaluated of the Peng-Robinson and Soave-Redlich-Kwong equations of state to simulate phase behavior and slim-tube displacement experiments. A good match of the experimental phase behavior was obtained. When this phase match was used to simulate the slim-tube displacement experiments, the agreement between the experimental and calculated results was poor. The effect of numerical dispersion has also been investigated.

7926 **(IKU-R—08.2613.02/01/85) Experimental study of wettability of reservoir rocks at high pressure and temperature.** Hjelmeland, O. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). May 1985. 244p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87750375.

This work is divided into two main parts: (1) An investigation of the effect pressure, temperature and oil composition on interfacial properties of a specific reservoir system, and (2) The development of an advanced high pressure equipment for wettability measurements. Contact angle measurements are used to quantify wettability. Interfucial tension between oil and water is measured and the degree of rigid film formation is quantified. A complete reversal of wettability from a predominantly oil-wet system at lower temperatures to a predominantly water-wet system at higher temperatures is found. Furthermore, the temperature strongly influences interfacial tension and rigid film formation. An improved high pressure apparatus for measuring interfacial properties has been constructed and successfully tested. 90 references.

7927 **(LBL—21804) Role of wettability in the break-up of liquid films inside constricted capillaries.** Gauglitz, P.A.; Radke, C.J. (California Univ., Berkeley (USA). Dept. of Chemical Engineering; Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 36p. (CONF-850942—58). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001880.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

To understand the role of wettability on gas-foam generation in porous media, this work considers the effect of conjoining/disjoining pressure on the dynamics of a liquid film forming an unstable collar in both straight and constructed cylindrical capillaries. A hydrodynamic lubrication analysis is presented to describe the time evolution of a thin viscous film under the influence of surface tension and the conjoining or disjoining forces. Time to break-up depends on the pore shape, the strength of the conjoining/disjoining forces, the initial film thickness, and also, on the fluid viscosity, interfacial tension, and unconstricted pore radius which combine to form a characteristic scaling time. Results show that both conjoining (intermediate wettability) and disjoining (strongly wetting) forces inhibit break-up. 33 refs., 9 figs., 1 tab.

7928 **(NIPER—164) National Institute for Petroleum and Energy Research: FY87 annual research plan.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1986. Contract FC22-83FE60149. 232p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86000303.

The National Institute for Petroleum and Energy Research (NIPER) will enter its fourth year of operation October 1, 1986, and this Annual Research Plan describes the work envisioned for that year. NIPER's program of research encompasses three different thrusts. The DOE funds a $5 million Base Program designed to undertake long-range, high-risk research on petroleum and similar materials that companies are generally unwilling to do. A second program, the Optional Program, cost-shares research on petroleum and substitute fossil fuels between DOE and contributing participants. For FY 87, the DOE maximum share will be $1 million and the remainder will be sponsored by other government agencies and industrial participants. The third program is a Work for Others Program which allows NIPER to solicit work from the private sector and others. This Annual Research Plan covers only the Base and Optional Programs. NIPER is organized into two research departments - Energy Production Research (EPR) and Fuels Research (FR). Projects in EPR deal with various aspects of enhanced oil recovery and include chemical flooding, gas injection processes, steam injection, and microbial enhanced oil recovery. Projects in FR are concerned with the impact of heavy oil and alternate fuels on processing and use of fuels. For Fiscal Year 1987, the Base Program will have 13 projects, eight in EPR and five in FR.

7929 **Surface characteristics of reservoir matrices subject to EOR process design.** Marchin, L.M.; Crocker, M.E. (National Institute for Petroleum and Energy Research, Bartlesville, OK 74005). pp 233-238 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Initial considerations to be included in the design of an enhanced oil recovery (EOR) field test are an overall chemical and physical characterization of the reservoir rock. The surface properties of the reservoir rock must be delineated in relation to its potential interactions with connate or injected fluids. A comparative study of the surface characteristics of a suite of sandstone and carbonate consolidated samples (cores) was performed. Characterization of rock surfaces included: bulk chemical analysis using inductively coupled plasma (ICP) spectroscopy, surface analysis and morphology using scanning electron microscopy (SEM), chemical analysis using x-ray diffraction, pore size distribution by capillary pressure analysis, and bulk and whole core cation exchange capacity (CEC) measurements. A flow-through method was used for whole core CEC measurements. Surface analysis using SEM/energy dispersive spectroscopy indicated more reactive minerals (up to 28 wt-pct) present on the surface of the sandstone in comparison to bulk sample analysis. The flow-through method for determining CEC resulted in values up to eight times less than the ammonium acetate method using crushed sandstone core. One plausible reason for these differences is that crushing the sample exposed additional sites for ion exchange to occur, whereas the cation-exchange as termined by the fluid flow method is determined on the specific rock matrix permeability system. However, in the flow-through experiments using carbonate cores large amounts of calcium were eluted (magnesium from dolomitic cores). This dissolution process could have implications in the applications of specific EOR chemicals or processes.

0204 Processing

REFER ALSO TO CITATION(S) 7928, 7932, 8232

7930 **(ESC-WR—86-07) Investment strategies for survival of the refinery industry in The Netherlands.** Van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jun 1986. 26p. Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The changes in the refineries in Western Europe and particularly in The Netherlands are discussed. First the major challenges to the refineries are described. Next the favourable position of the refineries located around the North Sea is explained. Furthermore the optimal investment route for a given long term oil product demand is calculated. From the results it is believed that the refineries in The Netherlands are economically viable in view of the moderate cost and investment requirements for an optimal expansion of the (upgrading) capacity.

7931 **(KFK-PEF—4-Vol.3, pp 719-729) Desulfurization of liquid petroleum and petroleum fractions by oxidation with excited oxygen.** Suhr, H.; Becker, E.; Nauenburg, K.; Schmid, H.; Iacocca, D.; Gil, J.; Ropero, M.; Uslar, J. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

A method is being developed to desulfurize petroleum and its fractions by means of a plasma oxidation. When these mixtures are subjected to an oxygen discharge, the sulfur compounds are oxidized. The products of oxidation are insoluble in the starting mixtures and form a second phase which can easily be separated on the basis of its higher specific gravity. The method has been tested with model compounds and simple mixtures.

0205 Products And By-products

7932 **(PB—86-239449/XAB) New trends in petrochemical research and development.** Schindlbauer, H. (United Nations Industrial Development Organization, Vienna (Austria)). 15 Nov 1985. 62p. (UNIDO-IS—576). NTIS, PC PC E04/MF A01.

Published as United Nations Industrial Development Organization, Vienna (Austria) Sectoral Working Paper Series No. 38.

The study was prepared by the Sectoral Studies Branch, Division for Industrial Studies, to be used as background material for the Third Consultation on the Petrochemical Industry to be held in Vienna, Austria, from 2 to 6 December 1985. The overview intends to give information to the developing countries on the possible effects the results of ongoing R and D can have on their future investment projects. At the same time it tries to present, in conclusion of the research situation investigated and the situation in the different developing countries, ideas on the general strategies to adopt in the R and D work.

7933 **(PB—87-105797/XAB) Analysis of fuel samples from Baltimore, Detroit, and Philadelphia. Technical report.** Warner-Selph, M.A.; Hare, C.T.; Harvey, C.A.; Adler, J. (Southwest Research Inst., Houston, TX (USA)). Jul 1986. 61p. NTIS, PC A04/MF A01.

The report describes samples of in-use gasoline analyzed from a selection of gasoline outlets that were not major (national) brands. A total of 123 samples were obtained from three cities; Baltimore, Detroit, and Philadelphia. All samples were analyzed for Reid Vapor Pressure (RVP), distillation temperature curve, methanol, ethanol, tertiary butyl alcohol (TBA), water content, and lead content. In addition, the Evaporative Index (EI) was calculated for each fuel.

0206 Health And Safety

7934 **(NP—7770025-Pt.2) Changing to lead-free gasoline. Consequences for Sweden's energy policy.** (Statens Energiverk, Stockholm (Sweden)). 1984. 116p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770025.

Individual papers are processed separately for the data bases. (PSB)

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 7930, 7944, 8232

7935 **(DOE/EIA—0202(86/4Q)) Short-term energy outlook. Quarterly projections, October 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 6 Nov 1986. 48p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87002259.

Quarterly forecasts of short-term energy supply, demand, and prices are revised in January, April, July, and October and analyzed annually. The projections in this volume extend through 1987. The forecasts are produced using the Short-Term Integrated Forecasting System model using two principal driving variables: a macroeconomic forecast and world oil price assumptions. The three projections for petroleum supply and demand are based on low, middle, and high crude oil price trajectories. The discussion and tables in this volume primarily refer to the middle, or base case, scenario and, unless otherwise noted, to the domestic situation. Other cases examine the sensitivity of total petroleum demand varying with prices, weather, and economic activity. Disucssions of the world oil price refer to the cost of imported crude oil to US refiners.

7936 **(DOE/EIA—0380(86/08)) Petroleum Marketing Monthly, August 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Oct 1986. 160p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. File Number DE87002261.

Information and statistical data about a variety of crude oils and refined petroleum products are presented. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0208 Waste Management

REFER ALSO TO CITATION(S) 8156, 8158

0209 Environmental Aspects

7937 **(IKU-R—02.0706.00/02/85) Numerical modelling. Recent advance with the particle-in-fluid concept.** Johansenc, Oe. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Mar 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750380.

This report presents results from the first year of a subtask of a more comprehensive research program "Dispersion of oil on sea". The objective of the subtask is the development of an improved oil spill simulation model, where chemical oil spill combat is considered, and which is capable of predicting both the spreading of oil at the surface and the distribution of oil in the water column. A review of the status of the work is given, with emphasis on studies related to modul parameters, such as spreading and evaporation. 5 references.

7938 **(IKU-R—02.0706.00/04/85) Dispersion of oil on sea-DOOS. Annual report 1984.** Celius, H.K.; Johansen, Oe.; Soerstroem, S.E. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Mar 1985. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750372.

The report summarizes the scientific work, organization and economy for the first year of study of the research program "Dispersion of oil on sea". The program has been orginized in 5 scientific tasks: (1) Laboratory testing of dispersant effectiveness; (2) Effect of demulsifiers and dispersants injected into a blowing oil stream; (3) Injection of chemicals. Consept study; (4) Numerical modeling; (5) Field tests. Work has commenced on all tasks. For task 1 and 2 the work has now been completed under this program. For tasks 3 and 5, the main work will be performed during 1985. A list of the published papers from the various tasks is given.

7939 **(IKU-R—02.0706.00/06/85) Dispersion of oil on sea-DOOS. Annual report for 1985.** Soerstroem, S.E. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Oseanografisk Senter). Jan 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750383.

The report summarizes the work and economy of the second year of study of the research program "Dispersion of oil on sea". The program has been organized in 5 scientific tasks: (1) Laboratory testing of dispersant effectiveness; (2) Effect of demulsifiers and dispersants injected into a blowing oil stream; (3) Injection of chemicals. Consept study; (4) Numerical modeling; (5) Experimental oil spill at Haltenbanken. The work in 1985 was mainly concerned about task 4 and task 5. Final work and reporting from task 1, 2 and 3 was accomplished in 1985. A list of the notes and reports written in the various tasks is given.

7940 **(IKU-R—02.0706/03/85) Studies of emulsification, emulsion prevention and underwater dispersion.** Celius, H.K.; Vassbotn, T. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Mar 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750381.

This is a report from the work performed under task 2: "Effect of demulsifiers and despersants injected into a blowing oil stream" of the research program "Dispersion of oil on sea". Three ad hoc experiments have been carried out involving laboratory studies in a small turbulent oil plume, tests with revolving flasks, and a small scale field test with a combined gas/oil plume. The results show that emulsion is formed in plume from underwater blowouts, and that this formation is prevented by small amounts (250 ppM) of demulsifiers or dispersants. Larger concentrations of dispersants (ca 2%) disperse the oil, and the oil is transported to the upper water layer in the gas/oil plume. None of the experiments have been designed as true scale tests, and the results cannot be directly transferred to operational, full scale conditions. The experiments have however narroved the necessary extent of studies, and allows for a simpler experimental procedure in the full scale field test planned for June 1985. 19 references.

7941 **(IKU-R—02.0706.10/01/85) Effectiveness testing of oil dispersants.** Nes, H.; Sandstad, M.; Knapstad, A. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Feb 1985. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750382.

Results obtained during second half of 1984 from laboratory testing of oil dispersants are summarized. A comparison is given of dispersant effectiveness results from experiments with oils of gradually increasing viscosities, performed with the Mackay test and the rotating funnel test (WSL/IVL-test). The report also includes results from dispersant effectiveness testing with weathered and emulsified oils. The results obtained in the Mackay-test show a dramatic decrease in dispersant effectiveness with increasing weathering and water content in the water-in-oil emulsions. This effect is not experienced with the WSL/IVL-test. The difference in energy input and the way of mixing are considered to be of great importance. 7 references.

7942 **(IKU-R—03.0732.00/01/85) Optical methods related to offshore problems.** Soerstroem, S.E. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Nov 1985. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750377.

The presented work has been directed towards the application of optical methods in offshore related problems (oil spills, suspended particles). It is based on a litterature review and on results from own experiments and surveys carried out during the period 1982-1985. The system described for monitoring oil pollution has been used in connection with a major experimental oil spill that took place in 1985. There is reason to believe that the offshore oil

industry also will find the methodology interesting for a number of other problems. 43 references.

7943 **(IKU-R—05/1704.00/02/85) Laboratory studies of the effect of oil dispersant on evaporation and dissolution.** Bowler, B.; Knapstad, A.; Due, A.; Sandstad, M. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Jun 1985. 80p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750379.

To study how addition of a dispersant influences the evaporation and dissolution of the oil in the water, four experiments with the Mackay apparatus have been carried out. Synthetic seawater, crude oil from the Ekofisk field in the North Sea, and Corexit 9527 as dispersant were used. The results show that addition of oil, premixed with dispersant to water, results in an immediate reduction in hydrocarbon evaporation rate compared to that observed when oil alone was added, although the air samples from experiments with premixed oil and dispersant have an increasing content of light aliphatics after 15 minutes. When the dispersant was added after 30 minutes the total amount of C5-C10 hydrocarbons in air increases. However, curves of each compound show an increase in the evaporation loss of lower boiling point compounds, and a reduction in the evaporative loss of the higher boiling point compounds. When the dispersant is introduced with the oil, the oil is dispersed through the water column, and hydrocarbons are dissolved about ten times more than without dispersant. The hydrocarbon content in water has a slight decrease after 15 minutes. This could be related to the increase of light aliphaties in the air samples after 15 minutes. 4 references.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 7934

7944 **(NP—7900118) The budgetary and economic effects of oil taxes.** (Congressional Budget Office, Washington, DC (USA)). Apr 1986. 68p. Superintendent of Documents, Congressional Sales Office, U.S. GPO, Washington, DC 20402. File Number TI87900118.

This paper analyzes taxes on oil or oil products. Such taxes have been proposed for a variety of purposes. One aim is to reduce the federal deficit. Another is to reduce US dependence on imported oil and its attendent risks to the economy and to national security. Some advocates of oil taxes see them as driving down further the world price of oil. Taxes are also favored as a way to assist the domestic oil industry, which is undergoing a severe contraction. Oil taxes would accomplish these goals in varying degree, depending on how a specific tax was designed. At one end of the spectrum, an oil import tariff would encourage conservation, the substitution of other fuels, and domestic exploration and production. At the other end, a general energy tax - such as an ad valorem tax on all fuels consumed - would lead to reductions in energy use but would do nothing to encourage the production and consumption of oil substitutes or the exploration and development of domestic oil supplies. Oil taxes also raise a variety of questions as to their effects on the economy, on foreign trade, on the distribution of income, and on specific industries such as refining. This paper examines five oil tax options: an import tariff of $5.00 per barrel on imported crude oil and $10.00 per barrel on imported refined products; a $5.00 per barrel excise tax on all crude oil (domestic and imported) and $5.00 per barrel on imported refined products; a $0.12 per gallon motor fuels tax; a 5% sales tax on all energy consumption; and a combination of a $0.06 per gallon tax on motor fuels together with a $2.50 tariff on imported crude and refined products. Since each tax would have different effects depending on the underlying level of world oil prices, and since there can be no certainty as to future oil prices, this report examines the taxes under three alternative assumptions: that oil prices hold steady over the next five years at levels of $23.00 per barrel, or $13.00 per barrel.

0230 Properties

REFER ALSO TO CITATION(S) 7928

7945 **Diesel cloud point determination needs uniformity.** Tsang, C.Y.; Liew, V.; Miranda, R. (NOVA/Husky Research Corp. Ltd., Calgary). *Oil and Gas Journal;* **84**: No. 42, 39-43(20 Oct 1986).

Cloud point values for diesel fuels, measured by the existing ASTM method, can vary by as much as 8°C. depending on the apparatus and technique used. These variations have an important effect on diesel-blending formulations. Research conducted at NOVA/Husky reveals cloud point discrepancies in results obtained by different laboratories testing the same fuel, and the impact of the discrepancies on blend ratios of distillates which, in turn, affect refinery economics. The major causes for the discrepancies, and recommended changes in test equipment specifications and test procedures to test the discrepancies, are presented in this article.

0240 Storage

7946 **(DOE/FE—0074) Drawdown and distribution management manual for the Strategic Petroleum Reserve.** (Department of Energy, Washington, DC (USA). Office of Strategic Petroleum Reserve). Oct 1986. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87000856.

The Drawdown and Distribution Management Manual (DDMM) provides a comprehensive guide to the planning, preparation, and operational processes associated with an SPR system response to an energy emergency. Although parts of the process may be unique to a particular situation, the manual describes the end-to-end continuity of the response by including those activities that would be common to most situations. This manual is intended to comply with overall DOE-wide policy contained in the Energy Emergency Management System (EEMS) currently being developed by the Assistant Secretary for International Affairs and Energy Emergencies. 6 refs., 5 figs.

0250 Combustion

REFER ALSO TO CITATION(S) 8467

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 7921, 7947

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 7923, 8170

7947 **(DOE/MC/21179—T1) Rock matrix and fracture analysis of flow in western tight gas sands. Quarterly technical progress report, January-March 1986.** Morrow, N.R.; Ward, J.S.; Brower, K.R.; Cather, S. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). 1986. Contract AC21-84MC21179. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010428.

The overall objective of this project is to show how gas can flow from the rock matrix to natural or induced fracures and be commercially produced. Flow of gas within the rock matrix has been shown to be largely controlled by sheet-like pores at grain boundaries, which are pressure sensitive. In this quarterly report, progress is reported in the following areas of advanced core analysis of low permeability gas sands: (1) surface area measurements; (2) helium porosimetry; (3) comparison of permeabilities for preserved cores and for cores subjected to drying; (4) pore space and fractures as related to diagenesis of multiwell sandstones; and (5) imbibition behavior of tight sands. 5 refs., 8 figs.

7948 **Sieves replaced by DEA system in gas plant to boost ethane recovery.** Root, C.R.; Changela, M.K. (Amoco Production Co., Houston, TX). *Oil and Gas Journal;* **84**: No. 42, 52-58(20 Oct 1986).

Modification of an acid-gas removal system at an Amoco Production Co. gas plant was undertaken to improve product treating and increase ethane recovery. The plant was originally constructed with molecular-sieve treaters designed to remove the trace amounts of hydrogen sulfide anticipated in the NGL. These treaters have now been replaced with a liquid-liquid, diethanolamine treating system designed for carbon-dioxide and sulfur-compound removal from NGL. The existing gas plant was designed to process 110 MMscfd of natural gas for 50% ethane and 92% propane recovery. These recovery levels reduce the residue-gas heating value to 1,000 BTU/cu ft. The plant was also designed for a peak gas throughput of 150 MMscfd with reduced liquid recovery levels. Minimum design liquid production was 290 gpm (10,000 b/d).

7949 **One-step process takes H/sub 2/S from gas stream.** Bhatia, K.; Allford, K.T. (NL Treating Chemicals, NL Industries Inc., Houston, TX). *Oil and Gas Journal;* **84**: No. 42, 44-49(20 Oct 1986).

A novel, one-step process selectively removes hydrogen sulfide from sourgases and converts dissolved hydrogen sulfide directly to sulfur in a bubble tower filled with a sweetener solution. The sweetener is a proprietary formulation consisting of an alkaline solution of oxidizing and buffering agents. Oxidation of hydrogen sulfide to sulfur is achieved by a liquid-phase oxidation technique. Various sour gas sweetening processes have been used for a number of years. Incentives for use of the one-step process include: 1. Improved economics for hydrogen sulfide removal based on cost-performance evaluations. 2. Simplicity of operation. 3. Low capital cost requirements for the gas processing plant. 4. Adaptability to existing process equipment. 5. Low toxicity and nonhazardous waste characteristics of the spent slurry generated by the hydrogen sulfide reaction. This article presents the current understanding of hydrogen sulfide oxidation chemistry in nitrite solutions, as well as research and field data related to the one-step process. The field data provide quantifiable proof that the one-step process is a viable economical alternative for hydrogen sulfide removal in properly designed and operated equipment.

0305 Health And Safety

7950 **(BIA—1/86) Safety-related investigations of electrostatically conducting floors of gas pressure control systems and compressor stations.** Kreutzkampf, F.; Uhlig, R. (Berufsgenossenschaftliches Inst. fuer Arbeitssicherheit, Sankt Augustin (Germany, F.R.)). 1986. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750301.

Electrostatic charges are a considerable danger in rooms endangered by explosions, as such charges leak away instantly causing fat sparks and therefore may represent and effective source of ignition for explosive mixtures. The construction of the floor and the actual state of electrostatic conductivity were determined for a large number of gas pressure control systems and compressor stations. The results of this investigation form the basis for further work. The leakage resistance of samples with different floor construction and different electrostatic leakage systems was measured in the laboratory. The electrostatically leaking floor coverings examined and the multi-coat paint systems were shown to be a clear improvement from the safety point of view over the non-leaking floor coverings. No worsening of the leakage capacity of the floor coverings examined could be found due to the effect of ageing and external climatic or mechanical effects. (HWJ).

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 7955

0309 Artificial Stimulation

7951 **(DOE/MC/21119—T9) Stimulation model for lenticular sands. Quarterly progress report, January 1-March 31, 1986.** Rybicki, E.F.; Sutrick, J.S. (Tulsa Univ., OK (USA). Dept. of Mechanical Engineering). 1986. Contract AC21-84MC21119. 19p. NTIS, PC A02. File Number DE86010302.

During the second quarter of Phase II, efforts were directed toward three tasks. One was including a subroutine to calculate pressure in the proppant transport model and preparing a users guide and tape for the computer program TUPROP1. The second was directed toward the proppant tracking capability of the program. The last task was combining the fracture geometry model and the proppant transport model. Progress on each of these areas is described. 5 refs., 1 fig., 5 tabs.

0320 Transport, Pipelines, And Handling

7952 **(PB—87-102141/XAB) Advanced systems development - interior piping materials/configuration. Topical report, performance criteria, March 1985-July 1986.** Sykes, R.C. (Foster-Miller, Inc., Waltham, MA (USA)). Jul 1986. 128p. NTIS, PC A07/MF A01.

The report covers developments of new natural gas piping systems for installation in residential and light commercial buildings. The total installed costs of these systems are to be competitive with those of electrical wiring serving the same types of appliances.

7953 **(PB—87-102190/XAB) Distribution Research Center Task 1: stresses in gas-distribution piping systems. Volume 1. Project synopsis, analyses, and conclusions and recommendations. Final report, December 1981-August 1984.** Arnold, J.M.; Todres, H.A.; Saha, N.C. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1986. 312p. NTIS, PC A14/MF A01.

A 16-inch gas pipeline, operating at 285 psig near Racine, Wisconsin was studied for a 2-year period to determine the effects of environmental changes and external loads on the soil-pipe system. Three locations were selected where the pipe ran beneath a concrete pavement. These locations were representative of shallow, normal, and deep depth-of-cover conditions. Extensive soil and pipe instrumentation were applied and monitored regularly at first, and continuously subsequently, when automatic data-logging equipment came available.

7954 **(PB—87-102208/XAB) Distribution Research Center Task 1: stresses in gas-distribution piping systems. Volume 2. Support studies, data base formulation, and data. Final report, December 1981-August 1984.** Arnold, J.M.; Todres, H.A.; Saha, N.C. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1986. 577p. NTIS, PC A25/MF A01.

A 16-inch gas pipeline, operating at 285 psig near Racine, Wisconsin was studied for a 2-year period to determine the effects of environmental changes and external loads on the soil-pipe system. Three locations were selected where the pipe ran beneath a concrete pavement. These locations were representative of shallow, normal, and deep depth-of-cover conditions. Extensive soil and pipe instrumentation were applied and monitored regularly at first, and continuously subsequently, when automatic data-logging equipment came available.

7955 **Custody transfer enhanced by electronic billing system.** Knox, R.M. (Transcontinental Gas Pipe Line Corp., Houston, TX). *Oil and Gas Journal;* **84**: No. 42, 50-52(20 Oct 1986).

Transcontinental Gas Pipe Line (TGPL) Corp. engineers have developed an electronic billing system for custody transfer

that can reduce the cost of doing business and improve the accuracy of transfer measurements. The system accurately measures gas flow and quality, transmits gas data to a central facility, provides a capability to review the collected data, prepares bills based upon these data, and reduces staffing associated with the data collection and billing process. On-line flow computers are keys to this electronic billing system. These computers, referred to as remote terminal units (RTU's), are currently in service at TGPL at more than 30 locations with 30 more locations due to be on-line within 6 months and an additional 40 locations due within 15 months. These RTU's will be obtaining gas data from metering stations located in New York, New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, Georgia, Louisiana, and Texas.

7956 **Real-time electronic monitoring of a pitted and leaking gas gathering pipeline.** Asperger, R.G.; Hewitt, P.G. (Petrolite Corp., St. Louis, MO 63119). *Materials Performance;* 25: No. 8, 47-57(Aug 1986).

Hydrogen patch, flush electrical resistance, and flush linear polarization proves wre used with flush coupons to monitor corrosion rates in a pitted and leaking sour gas gathering line. Four inhibitors were evaluated in stopping the leaks. Inhibitor residuals and the amount and ratio of water and condensate in the lines were measured at five locations along the line. The best inhibitor reduced reduced the pit-leak frequency by over a factor of 10. Inhibitor usage rate was optimized using the hydrogen patch current as a measure of the instantaneous corrosion rate. Improper pigging was identified as a cause of corrosion transients. This problem is discussed in relation to the pigging of pipelines in stratified flow where moving fluids are the carriers for continuously injected corrosion inhibitors.

0340 Combustion

7957 **(PB—87-102133/XAB) Direct injection of high-pressure natural gas in reciprocating engines. Topical report (Final), November 1984-28 February 1986.** Hoppie, L.O. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Aug 1986. 91p. NTIS, PC A05/MF A01.

The report covers developments of an injection system and combustion process that will permit a natural-gas-fueled engine to have a shaft efficiency as high as the shaft efficiency of the equivalent diesel engine.

04 Health And Safety

REFER ALSO TO CITATION(S) 8624

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 8045

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 7989

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 7985

0508 Spent Fuels Reprocessing

7958 **(DPSTD—84-96) Technical data summary: Uranium(IV) production using a large scale electrochemical cell.** Hsu, T.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1984. Contract AC09-76SR00001. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002642.

This Technical Data Summary outlines an electrochemical process to produce U(IV), in the form of uranous nitrate, from U(VI), as uranyl nitrate. U(IV) with hydrazine could then be used as an alternative plutonium reductant to substantially reduce the waste volume from the Purex solvent extraction process. This TDS is divided into three parts. The first part (Chapters I to IV) generally describes the electrochemical production of U(IV). The second part (Chapters V to VII) describes a pilot scale U(IV) production facility that was constructed and operated at an engineering semiworks area of SRP, referred to as TNX. The lst part (Chapter VIII) describes a preliminary design for a full-scale facility that would meet the projected need for U(IV) as a reductant in SRP's separations processes. The preliminary design was described in a Basic Data Summary for the U(IV) production facility, and a Venture Guidance Appraisal (VGA) was prepared from the Basic Data Summary. The VGA for the U(IV) process showed that because of the large capital investment required, this approach to waste reduction was not economically competitive with another alternative that required only modifying the ongoing Purex process at no additional capital cost. However, implementing he U(IV) process as part of an overall canyon renovation, presently scheduled for the 1990's, may be economically attractive. The purpose of this TDS is therefore to bring together the information and experience obtained thus far in the U(IV) program so that a useful body of information will be available to support any future development of this process.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 7988, 8439, 8440, 8441, 8444

7959 **(PNL—5728) WASTES: Wastes system transportation and economic simulation: Version 2, Programmer's reference manual.** Buxbaum, M.E.; Shay, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002838.

The WASTES Version II (WASTES II) Programmer's Reference Manual was written to document code development activities performed under the Monitored Retrievable Storage (MRS) Program at Pacific Northwest Laboratory (PNL). The manual will also serve as a valuable tool for programmers involved in maintenance of and updates to the WASTES II code. The intended audience for this manual are experienced FORTRAN programmers who have only a limited knowledge of nuclear reactor operation, the nuclear fuel cycle, or nuclear waste management practices. It is assumed that the readers of this manual have previously reviewed the WASTES II Users Guide published as PNL Report 5714. The WASTES II code is written in FORTRAN 77 as an extension to the SLAM commercial simulation package. The model is predominately a FORTRAN based model that makes extensive use of the SLAM file maintenance and time management routines. This manual documents the general manner in which the code is constructed and the interactions between SLAM and the WASTES subroutines. The functionality of each of the major WASTES subroutines is illustrated with "block flow" diagrams. The basic function of each of these subroutines, the algorithms used in them, and a discussion of items of particular note in the subroutine are reviewed in this manual. The items of note may include an assumption, a coding practice that particularly applies to a subroutine, or sections of the code that are particularly intricate or whose mastery may be difficult. The appendices to the manual provide extensive detail on the use of arrays, subroutines, included common blocks, parameters, variables, and files.

7960 **(PNL—6018) Methodology for determining criteria for storing spent fuel in air.** Reid, C.R.; Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003092.

Dry storage in an air atmosphere is a method being considered for spent light water reactor (LWR) fuel as an alternative to storage in an inert gas environment. However, methods to predict fuel integrity based on oxidation behavior of the fuel first must be evaluated. The linear cumulative damage method has been proposed as a technique for defining storage criteria. Analysis of limited nonconstant temperature data on nonirradiated fuel samples indicates that this approach yields conservative results for a strictly de-

creasing-temperature history. On the other hand, the description of damage accumulation in terms of remaining life concepts provides a more general framework for making predictions of failure. Accordingly, a methodology for adapting remaining life concepts to UO_2 oxidation has been developed at Pacific Northwest Laboratory. Both the linear cumulative damage and the remaining life methods were used to predict oxidation results for spent fuel in which the temperature was decreased with time to simulate the temperature history in a dry storage cask. The numerical input to the methods was based on oxidation data generated with nonirradiated UO_2 pellets. The calculated maximum allowable storage temperatures are strongly dependent on the temperature-time profile and emphasize the conservatism inherent in the linear cumulative damage model. Additional nonconstant temperature data for spent fuel are needed to both validate the proposed methods and to predict temperatures applicable to actual spent fuel storage.

0510 Marketing, Economics, And By-products

7961 (DOE/EIA—0477(85)) Domestic uranium mining and milling industry: 1985 viability assessment. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Nov 1986. 144p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87002620.

This report presents the third annual assessment of the domestic uranium mining and milling industry's resource capability, supply response capability, financial capability, and import commitment dependency. The data and analysis in support of this assessment and the report itself have been developed pursuant to requirements set forth in Section 23(b) of Public Law 97-415, the Nuclear Regulatory Commission (NRC) Authorization Act of 1982, which was enacted on January 4, 1983. The report provides information on recent uranium supply, demand, and marketing conditions, as well as projections of the domestic uranium industry's ability to continue to supply the needs of the domestic nuclear power industry through the year 2000. Industry capability is assessed under a variety of assumed conditions with respect to hypothetical disruptions of uranium imports.

0520 Waste Management

REFER ALSO TO CITATION(S) 7983, 7984, 7986, 7987, 8055, 8344, 8381, 8385, 8386, 8389, 8390, 8588, 8658, 8664, 8665

7962 (BMI/ONWI—597) Buckling design criteria for waste package disposal containers in mined salt repositories: Technical report. Mallett, R.H. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1986. Contract AC02-83CH10140. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002851.

This report documents analytical and experimental results from a survey of the technical literature on buckling of thick-walled cylinders under external pressure. Based upon these results, a load factor is suggested for the design of waste package containers for disposal of high-level radioactive waste in repositories mined in salt formations. The load factor is defined as a ratio of buckling pressure to allowable pressure. Specifically, a load factor which ranges from 1.5 for plastic buckling to 3.0 for elastic buckling is included in a set of proposed buckling design criteria for waste disposal containers. Formulas are given for buckling design under axisymmetric conditions. Guidelines are given for detailed inelastic buckling analyses which are generally required for design of disposal containers.

7963 (BMI/ONWI—601) Functional design criteria for an exploratory shaft facility in salt: Technical report. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1986. Contract AC02-83CH10140. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002635.

The purpose of the Functional Criteria for Design is to provide technical direction for the development of detailed design criteria for the exploratory shaft facility. This will assure that the exploratory shaft facility will be designed in accordance with the current Mission Plan as well as the Nuclear Waste Policy Act and 10 CFR Part 60, which will facilitate the licensing process. The functional criteria for design are not intended to limit or constrain the designer's flexibility. The following philosophies will be incorporated in the designs: (1) The exploratory shaft will be designed to fulfill its intended purpose which is to characterize the salt site by subsurface testing; (2) the design will minimize any adverse impact which the facility may cause to the environment and any damage to the site if it should be found suitable for a repository; (3) the health and safety of the public and of the workers will be an essential factor in the design; (4) sound engineering principles and practices will be consistently employed in the design process; (5) the exploratory shaft and related surface and subsurface facilities will be designed to be economical and reliable in construction, operation, and maintenance; and (6) the exploratory shaft facility will be designed in accordance with applicable federal, state, and local regulations, as well as all applicable national consensus codes and standards.

7964 (DOE/RW—0006-Rev.2) Integrated data base for 1986: spent fuel and radioactive waste inventories, projections, and characteristics. Revision 2. (Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 292p. (ORNL/M—215). NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87002346.

The Integrated Data Base (IDB) Program has compiled current data on inventories and characteristics of commercial spent fuel and both commercial and US Department of Energy (DOE) radioactive wastes through December 31, 1985, based on the most reliable information available from government sources, the open literature, technical reports, and direct contacts. Current projections of future waste and spent fuel to be generated through the year 2020 and characteristics of these materials are also presented. The information forecasted is consistent with the expected defense-related and private industrial and institutional activities and the latest DOE/Energy Information Administration (EIA) projections of US commercial nuclear power growth. The materials considered, on a chapter-by-chapter basis, are: spent fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, remedial action waste, and decommissioning waste. For each category, current and projected inventories are given through the year 2020, and the radioactivity and thermal power are calculated based on reported or calculated isotopic compositions.

7965 (DOE/RW—0101) Office of Geologic Respositories issues hierarchy for a Mined Geologic Disposal System (OGR/B-10). (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Sep 1986. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002725.

The Office of Geologic Repositories (OGR) has adopted an issues hierarchy for use by all Project Offices. The issues hierarchy provides a framework for representing issues related to regulatory requirements for siting and licensing a mined geologic disposal system (MGDS) and for describing the work that needs to be completed during site characterization to resolve those issues. The issues in the issues hierarchy are defined as the questions relating to the performance of the MGDS that must be resolved to demonstrate compliance with the applicable federal regulations (including 10 CFR Part 60, 10 CFR Part 960, 40 CFR Part 191, and 10 CFR Part 20). The issues hierarchy is structured around four broad areas of regulatory concern related to the requirements for siting and licensing an MGDS (postclosure performance, preclosure radiological safety, non-radiological environmental impacts, and feasibility and cost of MGDS development), and provides the framework for definition of the information needed to satisfy the applicable regulatory requirements in each of these areas. The purpose of this document is to present the issues hierarchy, describe the rationale used to develop the hierarchy, and describe how the issues hierarchy is used in program planning. Section 2 presents the overall rationale for the issues hierarchy, and explains the structure and organization of the hierarchy. Section 3 presents the issues hierarchy itself and Section 4 describes the basis for the development of individual issues. Section 5 provides a correlation between the issues and the applicable federal regulations being addressed. Section 6 describes how the issues drive development of plans in support of siting and

licensing requirements through use of an issue resolution strategy that includes performance allocation.

7966 **(DOE/SR-WM—87-1) Savannah River Interim Waste Management Program plan, FY-1987.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Sep 1986. Contract AC09-76SR00001. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87003058.

This document provides the program plan as requested by the Savannah River Operations office of the Department of Energy. The plan was developed to provide a working knowledge of the nature and extent of the interim waste management programs being undertaken by Savannah River (SR) contractors for the Fiscal Year 1987. In addition, the document projects activities for several years beyond 1987 to adequately plan for safe handling and storage of radioactive wastes generated at Savannah River and for developing technology for improved management of low-level solid wastes. A revised plan will be issued prior to the beginning of the first quarter of each fiscal year. In this document, work descriptions and milestone schedules are current as of the date of publication. Budgets are based on available information as of June 1986.

7967 **(DP-MS—86-96) Process and mechanical development for the Savannah River TRU Waste Facility.** Charlesworth, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 22p. (CONF-860905—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002640.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

A Transuranic Waste Facility will be designed and built to retrieve, process, and prepare noncombustible ^{238}Pu and ^{239}Pu waste that is now being retrievably stored for disposal. Development work is planned or is now in progress to support this effort, including cold run-in and testing of a large, low-speed shredder and material handling system, a bagless transfer system, a robotically controlled manipulator ("Telerobot"), and an incineration process. Preliminary tests of the shredder system, Telerobot, and bagless transfer system have been completed and an integrated test facility is being built that will allow extensive testing of these components. Cold run-in of a continuous incineration process designed to burn ^{238}Pu contaminated waste is now in progress.

7968 **(DP-MS—86-108) Establishment of new disposal capacity for the Savannah River Plant.** Albenesius, E.L.; Wilhite, E.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 19p. (CONF-860990—11). NTIS, PC A02. File Number DE87002658.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Two new low-level waste (LLW) disposal sites for decontaminated salt solidified with cement and flyash (saltstone) and for conventional solid LLW are planned for SRP in th next several years. An above-ground vault disposal system for saltstone was designed to minimize impact on the environment by controlling permeability and diffusivity of the wasteform and concrete liner. The experimental program leading to the engineered disposal system included formulation studies, multiple approaches to measurement of permeability and diffusivity, extensive mathematical modeling, and large-scale lysimeter tests to validate model projections. The overall study is an example of the systems approach to disposal site design to achieve a predetermined performance objective. The same systems approach is being used to develop alternative designs for disposal of conventional LLW at the Savannah River Plant.

7969 **(DP-MS—86-172) The process of performance assessment.** King, C.M.; Halford, D.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC09-76SR00001. 10p. (CONF-860990—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002654.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

An introductory review of the subject of "Performance Assessment" will be presented. Emphasis will be placed on the process of performance assessment from the standpoint of defining the process. Performance assessment, from evolving experience at DOE sites, has short-term and long-term subprograms, the components of which will be discussed. The role of mathematical modeling in performance assessment will be addressed including the pros and cons of current approaches. Finally, the "system/site/technology" issues as the focal point of this symposium will be reviewed.

7970 **(NTB—86-06) Weiach exploration well. Civil construction work, environmental protection and drilling techniques.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Apr 1986. 151p. (In German). Nagra, Ch-5401 Baden, Switzerland.

The exploration well at Weiach was realized as the second well within the Nagra Deep Drilling Program in Northern Switzerland. The drilling work was started January 10, 1983. Having reached the final depth of 2482.2 m on November 12, 1983, the test phase was then initiated and completed by April 3, 1985. The well drilled approx. 2000 m of sediments and approx. 500 m of crystalline rock. Oriented cores were taken over the major part of the well. The present report presents the drilling activities, civil construction work related to the site and precautions taken to account for environmental protection aspects. A chapter dealing with the commission representing members of the federal, cantonal and local authorities and reporting is given at the end of this report.

7971 **(NTB—86-09) Kaisten exploration well. Civil construction work, environmental protection and drilling techniques.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1986. 136p. (In German). Nagra, Ch-5401 Baden, Switzerland.

The exploration well at Kaisten was realized as the fifth well within the Nagra Deep Drilling Program in Northern Switzerland. The drilling work was startet February 13, 1984. Having reached the final depth of 1305.8 m on June 27, 1984, the test phase was initiated and completed by May 3, 1985. The well drilled approx. 300 m of sediments and approx. 1000 m of crystalline rock. Oriented cores were taken over the whole length of the well. The present report presents the drilling activities, civil construction work related to the site and precautions taken to account for environmental protection aspects. A chapter dealing with the commission representing members of the federal, cantonal and local authorities and about reporting is given at the end of this report.

7972 **(NTB—86-14) Water uptake and motion in highly densified bentonite.** Kahr, G.; Mueller-Vonmoos, F.; Kraehenbuehl, F.; Stoeckli, H.F. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1986. 46p. (In German). Nagra, Ch-5401 Baden, Switzerland.

Water uptake by the bentonites MX-80 and Montigel was investigated according to the classical method of determination of the heat immersion and the adsorption-desorption isotherms. In addition, the layer expansion of the montmorillonite was measured as a function of the water content. The evaluation of the adsorption isotherms according to Dubinin-Radushkevich and the stratification distances determined by x-ray confirmed gradual water uptake. Up to 10% water content, the water is adsorbed as a monolayer, up to 20%, as a bimolecular layer around the interlayer cations. The partial specific entropy could be determined from the approximative calculation of the partial specific enthalpy from the heats of immersion and the free enthalpy from the adsorption isotherms. From this it is evident that the interlayer water shows a high degree of order. In this condition, the mobility of the water molecules is considerably lower than in free water. From the adsorption isotherm and the layer expansion observed, it can be assumed that water can appear in the pore space only from approximately 25% water content. The spaces outwith the interlayer space and the surfaces of the montmorillonite particles are considered as pore space. If free swelling is prevented and with dry densities greater than 1.8 Mg/m/sup 3/ for the highly compacted bentonites, water uptake causes

a drastic reduction of the original pore space so that practically all the water is in the interlayer space. Calculation of the swelling pressure from the adsorption isotherms gives a good approximation of the measured swelling pressures. A montmorillonite surface of ca. 750 m/sup 2//g for both bentonites can be derived from a Dubinin-Radushkevich analysis of the adsorption isotherm. Water uptake into the compacted unsaturated bentonites can be described as diffusion with a diffusion coefficient of the order of magnitude of 3.10/sup -10/ m/sup 2//s.

7973 **(PNL—6066) Modified Hazard Ranking System/ Hazard Ranking System for sites with mixed radioactive and hazardous wastes: Software documentation.** Stenner, R.D.; Peloquin, R.A.; Hawley, K.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 321p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87002844.

The mHRS/HRS software package was developed by the Pacific Northwest Laboratory (PNL) under contract with the Department of Energy (DOE) to provide a uniform method for DOE facilities to use in performing their Conservation Environmental Response Compensation and Liability Act (CERCLA) Phase I Modified Hazard Ranking System or Hazard Ranking System evaluations. The program is designed to remove the tedium and potential for error associated with the performing of hand calculations and the interpreting of information on tables and in reference books when performing an evaluation. The software package is designed to operate on a microcomputer (IBM PC, PC/XT, or PC/AT, or a compatible system) using either a dual floppy disk drive or a hard disk storage system. It is written in the dBASE III language and operates using the dBASE III system. Although the mHRS/HRS software package was developed for use at DOE facilities, it has direct applicability to the performing of CERCLA Phase I evaluations for any facility contaminated by hazardous waste. The software can perform evaluations using either the modified hazard ranking system methodology developed by DOE/PNL, the hazard ranking system methodology developed by EPA/MITRE Corp., or a combination of the two. This document is a companion manual to the mHRS/HRS user manual. It is intended for the programmer who must maintain the software package and for those interested in the computer implementation. This manual documents the system logic, computer programs, and data files that comprise the package. Hardware and software implementation requirements are discussed. In addition, hand calculations of three sample situations (problems) with associated computer runs used for the verification of program calculations are included.

7974 **(RHO-RE-EV—65P) Estimation of geomechanical subsidence at Hanford low-level solid waste disposal sites: Empirical analysis based on geological engineering.** Phillips, S.J.; Gilbert, T.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1985. Contract AC06-77RL01030. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000043.

Geotechnical/geomechanical subsidence is of concern at several Hanford Site low-level waste disposal locations. Subsidence may result in long-term maintenance, or perhaps, loss of confinement of contaminants within the boundaries of specific disposal sites. A preliminary method to estimate the magnitude of subsidence is reported. Additionally, graphic relationships are reported that permit estimation of depth and volume of subsidence ground surface features.

7975 **(RHO-RE-EV—89P) Preliminary assessment of the TRAC [Tracks Radioactive Components] model as a predictor of key radionuclide inventories.** Adams, M.R.; Jensen, L.; Schulz, W.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1986. Contract AC06-77RL01030. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002774.

A program is being implemented to characterize the radionuclide and hazardous waste constituents stored in single-shell tanks. This document deals specifically with the characterization of radionuclides. Detailed knowledge of the composition of the radionuclide and hazardous chemical wastes stored in single-shell tanks at Hanford is essential for making decisions about disposal of these wastes. Currently, both the Tracks Radioactive Components (TRAC) computer model and sampling/analysis data for selected tanks are being used to characterize wastes in single-shell tanks. Wastes in nine single-shell tanks have now been sampled and analyzed for comparison with TRAC model inventory predictions. Six key environmentally important radionuclides (^{14}C, ^{99}Tc, ^{129}I, ^{239}Pu, ^{240}Pu, and ^{241}Am) have been analyzed in waste cores from each of the tanks. A preliminary assessment of the TRAC model indicates that, except for ^{14}C, it is a reasonably satisfactory predictor of the locations of the key radionuclides on a tank-by-tank basis in that TRAC numbers agreed with sampling predictions for at least half the tanks within the 95% confidence interval. It is recommended that the TRAC model continue to be used as a predictive tool. Additional tanks predicted to have high inventories of /sup 239,240/Pu and ^{14}C should be sampled followed by the random sampling of a number of tanks. This recommendation is based on the fact that for insoluble radionuclides TRAC-aided sampling is more efficient in terms of cost and personnel exposure than the alternative of selecting tanks at random for sampling. For soluble radionuclides, TRAC-aided sampling is at least as efficient as random sampling and certainly more efficient than sampling all the tanks. Therefore, the current approach is a more efficient way to locate and account for inventories of the key radionuclides.

7976 **(RHO-RE-SR—55P) Hanford Waste Vitrification Plant: Preliminary description of waste form and canister.** Mitchell, D.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 29 Aug 1986. Contract AC06-77RL01030. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003149.

In July 1985, the US Department of Energy's Office of Civilian Radioactive Waste Management established the Waste Acceptance Process as the means by which defense high-level waste producers, such as the Hanford Waste Vitrification Plant, will develop waste acceptance requirements with the candidate geologic repositories. A complete description of the Waste Acceptance Process is contained in the Preliminary Hanford Waste Vitrification Plant Waste Form Qualification Plan. The Waste Acceptance Process defines three documents that high-level waste producers must prepare as a part of the process of assuming that a high-level waste product will be acceptable for disposal in a geologic repository. These documents are the Description of Waste Form and Canister, Waste Compliance Plan, and Waste Qualification Report. This document is the Hanford Waste Vitrification Plant Preliminary Description of Waste Form and Canister for disposal of Neutralized Current Acid Waste. The Waste Acceptance Specifications for the Hanford Waste Vitrification Plant have not yet been developed, therefore, this document has been structured to corresponds to the Waste Acceptance Preliminary Specifications for the Defense Waste Processing Facility High-Level Waste Form. Not all of the information required by these specifications is appropriate for inclusion in this Preliminary Description of Waste Form and Canister. Rather, this description is limited to information that describes the physical and chemical characteristics of the expected high-level waste form. The content of the document covers three major areas: waste form characteristics, canister characteristics, and canistered waste form characteristics. This information will be used by the candidate geologic repository projects as the basis for preliminary repository design activities and waste form testing. Periodic revisions are expected as the Waste Acceptance Process progresses.

7977 **(SAND—85-0323) An evaluation of WIPP structural modeling capabilities based on comparisons with South Drift data.** Morgan, H.S.; Stone, C.M.; Krieg, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 74p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87002634.

The creep response of rock salt around a long uniform excavation of rectangular cross-section has been computed with the structural finite element code SANCHO, and the results are compared with field data. The excavation, known as the South Drift, is part of the Waste Isolation Pilot Plant (WIPP) facility. The geomechanical model used in the calculations is quite complex and includes constitutive models based on standard laboratory creep tests. Because closure and closure rate measurements are at least three times larger than computed values, a thorough investigation of the

many parameters in the geomechanical model is presented. This investigation indicates that variations to parameters not related to the constitutive model for halite cannot produce the type of changes in the closure histories needed to produce good agreement with data. Thus, the reason for the discrepancy is attributed to the parameters in the constitutive model for halite. However, none of the halite parameters investigated could produce the measured behavior. Several areas for future study have been identified.

7978 **(SAND—85-0815) Preliminary validation of geology at site for repository surface facilities, Yucca Mountain, Nevada.** Neal, J.T. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003082.

Boreholes and seismic refraction measurements have confirmed that the eastward dipping Tiva Canyon cap rock unit underlies much of the reference conceptual site for repository surface facilities. The style of faulting east of Exile Hill is imbricate normal, as seen elsewhere at the Yucca Mountain site. The alluvial cover ranges in thickness from zero at Exile Hill to 27 m at a point some 500 m east of Exile Hill. In situ primary wave velocities (Vp) average about 1 km/sec in alluvium and 1.4 km/sec in tuff - relatively low values for both. The range and overlap of values virtually precludes using velocity to distinguish between the two; consequently, structure is difficult to discern by seismic techniques. The information gained confirms the earlier conclusion that the low-angle alluvial wedge and low acoustic impedance contrast would not significantly amplify incoming seismic motion. The investigations did not establish whether bedrock faults penetrate the overlying alluvium. The information gained does not indicate that there are subsurface conditions that would adversely impact on site suitability; design options readily permit the accommodation of existing conditions at the site. Trenching investigations will be needed to verify that the location of the waste-handling facilities will not be subjected to surface rupture by faulting.

7979 **(SAND—86-1364) Hydraulic-test interpretations for Well DOE-2 at the Waste Isolation Pilot Plant (WIPP) site.** Beauheim, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002631.

Eleven different zones were tested in Well DOE-2 in five phases of testing between 1984 and 1986. Testing techniques included a constant-head, borehole-infiltration test, drill-stem tests, slug tests, pressure-pulse tests, and multiwell pumping tests. Four of the zones tested - the lower Dewey Lake Red Beds, the Tamarisk Member of the Rustler Formation, the lower unnamed member of the Rustler Formation and Rustler/Salado contact, and the entire Salado Formation - had permeabilities too low to measure with the equipment and test techniques used. The other zones had permeabilities ranging over six orders of magnitude. No saturated strata were encountered above the Rustler Formation, although parts of the middle Dewey Lake Red Beds appear to have appreciable permeability.

7980 **(UCRL—53688) Post-test thermomechanical calulations and preliminary data analysis for the Spent Fuel Test: Climax.** Butkovich, T.R.; Patrick, W.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002742.

The Spent Fuel Test - Climax (SFT-C) was conducted to evaluate the feasibility of retrievable deep geologic storage of commercially generated, spent nuclear-reactor fuel assemblies. Thermomechanical response of the SFT-C was calculated before the test began using the finite-element structural analysis code ADINA and its companion heat transfer code ADINAT. While we found that the level of agreement between measured and calculated rock displacements was quite good, we needed to revise certain aspects of the heat transfer calculation, material properties, and in situ stresses to incorporate information obtained during and after the heated phase of the test. The post-test calculations reported here were performed using the best available input parameters, thermal and mechanical properties, and power levels that were directly measured or inferred from measurements made during the test. This report documents the results of these calculations and compares those results with selected measurements made during the 3-year heating phase and 6-month cooling phase of the SFT-C.

7981 **(USGS-OFR—86-205) Borehole gravity meter survey in drill hole USW G-4, Yucca Mountain Area, Nye County, Nevada.** Healey, D.L.; Clutsom, F.G.; Glover, D.A. (Geological Survey, Denver, CO (USA)). 1986. Contract AI08-78ET44802. 23p. US Geological Survey, Box 25425 Federal Center, Denver, CO 80225. File Number TI87001783.

Drill hole USW G-4 was logged with the US Geological Survey borehole gravity meter (BHGM) BH-6 as part of a detailed study of the lithostratigraphic units penetrated by this hole. Because the BHGM measures a larger volume of rock than the conventional gamma-gamma density tool, it provides an independent and more accurate measurement of the in situ average bulk density of thick lithologic units. USW G-4 is an especially important hole because of its proximity to the proposed exploratory shaft at Yucca Mountain. The BHGM data were reduced to interval densities using a free-air gradient (F) of 0.3083 mGal./m (0.09397 mGal/ft) measured at the drill site. The interval densities were further improved by employing an instrument correction factor of 1.00226. This factor was determined from measurements obtained by taking gravity meter BH-6 over the Charleston Peak calibration loop. The interval density data reported herein, should be helpful for planning the construction of the proposed shaft.

7982 **Iodine fixation studies at the Pacific Northwest Laboratory.** Burger, L.L.; Scheele, R.D. (Pacific Northwest Lab., Richland, WA 99352). pp 255-276 of Management modes for iodine - 129. Hebel, W.; Cottone, G. New York, NY; Harwood Academic Pub. (1982). (CONF-810971—). Contract AC06-76RL01830.

From Specialists' meeting on radioiodine management; Brussels, Belgium (25 Sep 1981).

The aim of the iodine program at PNL is to develop technologies that will provide safe and effective removal and packaging of /sup 129/I for interim storage and shipping and for permanent isolation. Iodine recovery and fixation processes, and the evaluation of fixation compounds and materials are included in the program. Iodine-containing compounds have been evaluated on the basis of chemical and thermal stability, solubility, and cost and availability. Other materials examined were silver mordenite and faujasite, AC-6120, and a synthetic iodine-containing sodalite. Work on silver-containing absorbents includes study of the effects of operating parameters on the removal of organic iodides by reduced silver mordenite, on the recycle of silver mordenite, and on the general mechanisms of iodine fixation on metal zeolites. The authors show that normally only a small amount of the total silver capacity is utilized in forming stable silver-iodine compounds. The remainder of the iodine absorbed is held in a less stable complex and can be removed by heating.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 8385, 8390, 8589

7983 **(DOE/EA—0317) Environmental assessment of remedial action at the Tuba City uranium mill tailings site, Tuba City, Arizona.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Nov 1986. 278p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87002840.

This document assesses and compares the environmental impacts of various alternatives for remedial action at the Tuba City uranium mill tailings site located approximately six miles east of Tuba City, Arizona. The site covers 105 acres and contains 25 acres of tailings and some of the original mill structures. The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), Public Law 95-604, authorizes the US Department of Energy to clean up the site to reduce the potential health impacts associated with the residual radioactive materials remaining at the site and at associated properties off the site. The US Environmental Protection Agency

promulgated standards for the remedial actions (40 CFR Part 192). Remedial actions must be performed in accordance with these standards and with the concurrence of the Nuclear Regulatory Commission. The proposed action is to stabilize the tailings at their present location by consolidating the tailings and associated contaminated materials into a recontoured pile. A radon barrier would be constructed over the pile and various erosion control measures would be taken to assure the long-term stability of the pile. Another alternative which would involve moving the tailings to a new location is also assessed in this document. This alternative would generally involve greater short-term impacts and costs but would result in stabilization of the tailings at a more remote location. The no action alternative is also assessed in this document.

7984 **(NUREG—1101-Vol.3) Onsite disposal of radioactive waste: Estimating potential groundwater contamination.** Goode, D.J.; Neuder, S.M.; Pennifill, R.A.; Ginn, T. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Nov 1986. 153p. NTIS, PC A08/MF A01 - GPO. File Number TI87900158.

Volumes 1 and 2 of this report describe the NRC's methodology for assessing the potential public health and environmental impacts associated with onsite disposal of very low activity radioactive materials. This volume (Vol. 3) describes a general methodology for predicting potential groundwater contamination from onsite disposal. The methodology includes formulating a conceptual model, representing the conceptual model mathematically, estimating conservative parameters, and predicting receptor concentrations. Processes which must generally be considered in the methodology include infiltration, leaching of radionuclides from the waste, transport to the saturated zone, transport within the saturated zone, and withdrawal at a receptor location. A case study of shallow burial of iodine-125 illustrates application of the MOCMOD84 version of the US Geological Survey's 2-D solute transport model and a corresponding analytical solution. The appendices include a description and listing of MOCMOD84, descriptions of several analytical solution techniques, and a procedure for estimating conservative groundwater velocity values.

0540 Health And Safety

REFER ALSO TO CITATION(S) 7983

7985 **(NUREG/CR—4447) Radiological source terms resulting from sabotage to transportation casks: Final report.** Miller, N.E.; Fentiman, A.W.; Kuhlman, M.R.; Ebersole, H.N.; Trott, B.D.; Orban, J.E. (Battelle Columbus Labs., OH (USA)). Nov 1986. 104p. (BMI—2131). NTIS, PC A06/MF A01 - GPO. File Number TI87900161.

The Nuclear Regulatory Commission (NRC) promulgated a rule, 10 CFR 73.37, which established requirements for safeguarding shipments of spent fuel to reduce the risk from acts of sabotage of highly radioactive materials. After the rule became effective, experimental programs conducted by Battelle for the NRC and by Sandia for the DOE showed the consequences of an attack using explosives on a shipment of PWR spent fuel were significantly less than had been indicated by earlier analytical studies. As a result, NRC is considering modifying the safeguards requirements. In support of NRC's efforts to modify the rule, Battelle has conducted additional experimental studies to evaluate the consequences of attacks on shipments of high-temperature gas-cooled reactor (HTGR) spent fuel, nonpower reactor (NPR) spent fuel, and vitrified high-level waste (HLW). Model casks containing surrogates of the spent fuels or high-level waste were penetrated by the jet from a precision shaped charge. Air samples collected after each test were used to estimate the quantities of respirable material released after the cask was penetrated. Results of the tests were scaled by specially developed scaling factors to estimate the releases that may occur from attacks on full-sized shipments of the materials. It was concluded that the sabotage of shipments of HTGR spent fuel, NPR spent fuel, or vitrified HLW should have no greater consequences than those predicted for shipments of PWR spent fuel.

7986 **(ORNL/Sub—85-97368/2) Monitoring plan for characterization of the Building 3028 leak site.** (Geraghty and Miller, Inc., Oak Ridge, TN (USA)). Jun 1986. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002962.

The Oak Ridge National Laboratory (ORNL) has established a Remedial Action Program to characterize, manage, and restore areas where past use has resulted in residual contamination of facilities or the environment. In March of 1985, a leak was discovered in the low-level waste (LLW) line leading from Building 3028 during excavation for the construction of condensate traps in the line. Radiation readings as high as 200 R/hr were measured in the contaminated soil in contact with the pipeline. A dye test conducted on the suspect section of line indicated the presence of the leak underneath the southeast corner of the building. The line at that point serves both Building 3028 and Building 3047. A wide variety of radionuclides are processed or produced in the hot cells of Building 3047. All available published and unpublished background information on contaminant inventory, geology, hydrology, and ecology of the site is presented in this report. A monitoring plan is proposed to provide a preliminary assessment of the extent of contamination at the leak site and to provide additional geologic and hydrologic data for evaluating possible contaminant migration pathways.

7987 **(ORNL/TM—9996) Preliminary analysis of environmental regulations related to remedial action activities at the Oak Ridge National Laboratory: Environmental Sciences Division Publication No. 2695.** Voorhees, L.D.; Saylor, R.E. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002974.

Past research and development activities at Oak Ridge National Laboratory (ORNL) have resulted in the presence of several areas where low-level radioactive and/or hazardous waste have been disposed of or that have been contaminated through accidental spills or planned releases of radionuclides. Although these areas have been monitored and controlled to ensure that on-site and off-site releases of contaminants are within applicable Department of Energy (DOE) guidelines, ORNL established the Environmental Restoration and Facilities Upgrade (ERFU) Program to address formally the immediate and long-range needs of meeting all applicable federal and state regulations regarding waste disposal. The environmental laws, regulations, and DOE Orders governing the cleanup activities are numerous and complex. Hence, a synthesis of the principal regulations related to the ERFU Program is presented to facilitate efficient planning for characterization and cleanup of contaminated sites. Because of regulatory decisions made after this report was finalized, several statements presented herein may no longer apply to the ERFU Program. Nevertheless, the report is issued as originally written so that ORNL's early planning efforts to comply with environmental laws and legislation are formally documented. Several general principles to consider when developing a plan for environmental compliance - which would be of use to others who must comply with legislation related to the cleanup of sites contaminated with radionuclides and hazardous chemicals - are also discussed.

7988 **(SAND—85-1001) Demonstration sensitivity analysis for RADTRAN III.** Neuhauser, K.S.; Reardon, P.C. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002632.

A demonstration sensitivity analysis was performed to: quantify the relative importance of 37 variables to the total incident free dose; assess the elasticity of seven dose subgroups to those same variables; develop density distributions for accident dose to combinations of accident data under wide-ranging variations; show the relationship between accident consequences and probabilities of occurrence; and develop limits for the variability of probability consequence curves.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 8247, 8414

7989 (K/OA—5942) Limited frequency-unannounced access strategy measurement technology demonstration and evaluation session, July 29-August 1, 1985. Cooley, J.N. (comp.). (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1985. Contract AC05-84OT21400. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001852.

The US Department of Energy's Enrichment Safeguards Program sponspred a four-day evaluation session in late July 1985 to demonstrate the measurement of methodology developed by the United States for use by the International Atomic Energy Agency (IAEA) in international safeguards inspections of gas centrifuge enrichment plants. Participants included technical representatives from Australia, the Federal Republic of Germany, Japan, the Netherlands, the inspectorate organizations of Euratom and the IAEA, Los Alamos National Laboratory, and Martin Marietta Energy Systems, Inc., together with delegates from the US Arms Control and Disarmament Agency, the US Department of Energy, and the US Department of State. The United Kingdom was also invited to participate but did not send a representative. Summarized are: (1) the technical information presented by the US inspection strategy developers; (2) the demonstration of the detection hardware and verification measurements; (3) status information presented by the participating technology holders on enrichment plant safeguards development work in their respective countries; and (4) observations and concluding statements from session participants. 4 refs., 2 tabs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 8351

7990 (DPST—85-133-10/86-3) ^{238}Pu fuel form activities, October 1, 1985-March 31, 1986. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1986. Contract AC09-76SR00001. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002692.

This report summarizes production of $^{238}PuO_2$ fuel forms for use in radioisotopic thermoelectric generators (RTG's) in the Plutonium Fuel Form (Puff) Facility at the Savannah River Plant.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 8603

7991 Stress-selected Chlamydomonas reinhardtii for photoproduction of hydrogen. Ward, B.; Reeves, M.E.; Greenbaum, E. (Oak Ridge National Lab., Oak Ridge, TN 37830). pp 501-507 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Data are presented which support the proposal that variability for anaerobiosis tolerance exists among unialgal cultures of C. reinhardtii. For strain UTEX 2246, at least, retention of competence for photoproduction of hydrogen under prolonged anaerobiosis appears to be directly associated with maintenance of cellular structural integrity. The stress-selection and cell-cloning technique might be applied to other algal strains to obtain pure cultures having enhanced capacity for sustained photoproduction of hydrogen. 6 refs., 1 figs., 2 tabs.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 7874, 7877, 7878, 8031, 8609

7992 (DOE/PC/70030—T3) Novel Fischer-Tropsch slurry catalysts and process concepts for selective transportation fuel production. Quarterly technical progress report, 1 April-30 June 1985. Carroll, W.E.; Cilen, N.; Motika, S.A.; Withers, H.P. Jr. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jul 1986. Contract AC22-84PC70030. 306p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87001393.

In the third quarter work continued on the two major tasks: Task 2 - Development of Improved Supported Catalyst Compositions; and Task 3 - Slurry Reactor Kinetic Studies. Within Task 2, work was accomplished in studying the effect of catalyst activation procedure on activity and selectivity of the basecase $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$ composition. Activation with pure H_2 gave a >100% increase in both bulk and specific activity in gas phase tests at 220°C compared to the standard syngas activation. However, the activity enhancement was somewhat less at higher run temperatures. To establish a reference for the cobalt carbonyl-based catalysts, a catalyst was prepared and gas phase tested in which cobalt nitrate was used as the cobalt source and supported on zirconated alumina. Syngas and pure H_2 activation were also compared for this catalyst. A $Co_2(CO)_8/Zr(OPr)_4/Al_2O_3$ catalyst with increased cobalt loading was prepared to examine the effect of metal loading on catalyst performance. Initial analysis of these catalysts has been carried out using x-ray photoelectron spectroscopy (XPS) and H_2 chemisorption. Four catalysts were screened in the slurry phase reactors. These included the titanium promoted $Co_2(CO)_8$ on alumina catalyst, the $Co_2(CO)_8/Zr(OPr)_4$ on alumina composition having a higher Co/Zr weight ratio of 1.15, and the potassium promoted mixed-metal composition of $FeCo_3(CO)_{12}$ on alumina. The fourth slurry screening test was done to examine the effect of pure H_2 activation on the performance of the basecase $Co_2(CO)_8/Zr(OPr)_4$ on alumina catalyst. 63 figs., 131 tabs.

7993 (DOE/PC/70030—T4) Novel Fischer-Tropsch slurry catalysts and process concepts for selective transportation fuel production. Quarterly technical progress report, 1 October-31 December 1985. Carroll, W.E.; Cilen, N.; Withers, H.P. Jr. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jul 1986. Contract AC22-84PC70030. 245p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87001792.

In the fifth quarter work continued on the two major tasks: Task 2 - Development of Improved Supported Catalyst Compositions and Task 3 - Slurry Reactor Kinetic Studies. Four catalysts were prepared during this quarter. A $Co/Zr/SiO_2$ catalyst was prepared from a more conventional cobalt source (cobalt nitrate) to establish a comparative basis for the silica-supported, cobalt carbonyl based catalysts. A Zr-promoted Ru catalyst was prepared on silica, since the silica support provided enhanced performance for the cobalt catalyst. TiO_2 was examined in a dual purpose support/promoter role for the Co catalyst by preparing $Co_2(CO)_8$ on TiO_2. A Zr-promoted, $Fe_3(CO)_{12}$ on silica catalyst was prepared to establish the inherent water-gas shift activity of this type of Fe-based catalyst. During this quarter five gas phase screening tests were performed and slurry screening tests were performed on three catalysts and an extended test was initiated on a fourth catalyst. Results are discussed. Catalyst characterization during this quarter centered around surface area determination and H_2 chemisorption on the $Co/Zr/SiO_2$ catalyst. The surface area was 316 m^2/g, which was 50% greater than the $Co/Zr/Al_2O_3$ catalyst and likely accounts for some of its enhanced activity. The $Co/Zr/SiO_2$ catalyst had an active metal surface area which was an order of magnitude larger than that of the alumina catalyst, indicative of improved dispersion. The chemisorption data was similar to literature values reported for Co on silica. Data from the slurry test of the H_2-activated $Co/Zr/$

Al_2O_3 basecase catalyst was fitted to two kinetic expressions. 7 refs., 50 figs., 105 tabs.

7994 **(LBL—22293) Triterpenoid biosynthesis in Euphorbia lathyris.** Skrukrud, C.L.; Taylor, S.E.; Hawkins, D.R.; Calvin, M. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 7p. (CONF-8608132—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001727.

From Metabolism, function and structure of plant lipids conference; Davis, CA, USA (25 Aug 1986).

Experiments investigating the roles of HMG-CoA reductase and fructose-2,6-bisphosphate in the control of the production of triterpenoids in Euphorbia lathyris latex are described. The occurrence of 24-methylenelanosterol and butyrospermol in latex is reported. Preliminary steps in the purification of HMG-CoA reductase are presented. 6 refs., 1 fig., 3 tabs.

7995 **Development of water slurry gasification systems for high-moisture biomass.** Butner, R.S.; Sealock, L.J. Jr.; Elliott, D.C. (Pacific Northwest Lab., Richland, WA 99352). pp 3-16 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The development of a new biomass gasification system by Pacific Northwest Laboratory is described. The system promises to allow the efficient thermochemical conversion of high-moisture biomass feedstocks. The reactor operates at 400 to 450°C and 4000 to 5400 psig to allow the gasification of water-biomass slurries containing up to 95% moisture. Initial results of gasification studies are presented. Raw product gases containing up to 40% methane have been obtained with carbon conversions in excess of 95%. Feedstocks being studied include aquatic plants, agricultural residues, food processing waste, and effluent from an anaerobic methane digestor. 11 refs., 4 figs., 5 tabs.

7996 **Indirect, radiant heating for biomass pyrolysis and gasification.** Clements, L.D. (Univ. of Nebraska-Lincoln, Lincoln, NE 68588-0126). pp 91-98 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The design of a biomass reactor for the production of synthesis gas is effectively a heat exchanger design. Key factors which can enhance the yield and quality of the product gas are: (1) indirect heating at heat fluxes of 5 to 30 W/cm² (promotes gasification rather than liquefaction); (2) reactant temperatures in excess of 500°C (promotes gasification); and (3) steam addition (promotes char gasification). In addition, any commercially attractive unit must be capable of processing at a reasonably high solids feed rate. Mechanical simplicity is highly desirable and the ability to scaleup the process is mandatory. These attributes have been incorporated into the fire-tube concept. 12 refs., 4 figs., 2 tabs.

7997 **Vacuum pyrolysis of biomass in a multiple-hearth furnace.** Roy, C.; Lemieux, R.; De Caumia, B.; Pakdel, H. (Univ. de Sherbrooke, Sherbrooke, Quebec, canafa J1K 2R1). pp 107-113 of Biotechnology and bioengineering symposiun No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The pyrolysis technique, with its ability to convert wood into charcoal, tar, and gas, has become an area of increasing research activity since biomass has been recognized as a potential alternative source to fossil fuels for energy products and commodity chemicals. Unless they are processed or upgraded, pyrolytic tars have found little utility because of their chemical complexity and poor chemical and physical properties. As a consequence, a significant portion of biomass pyrolysis research activity today is in process engineering, where the objective is to produce high yields of marketable chemicals (e.g., acetic and formic acids). The vacuum pyrolysis process, which is under further development at the Universite' de Sherbrooke, appears to be a useful technique for the production of high organic liquid yield from wood. The original preliminary data reported in this article indicate that this approach has the potential to achieve selective liquid product recovery. 6 refs., 2 figs., 4 tabs.

7998 **High rate dry anaerobic composting process for the organic fraction of solid wastes.** De Baere, L.; Verdonck, O.; Verstraete, W. (ACEC NOORD, Gent, Belgium; State Univ. of Gent, Belgium). pp 321-330 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

A solid-state fermentation process was developed for the stabilization of the organic fraction of solid waste. The process consists of an intensive anaerobic fermentation at 30 to 35% total solids, followed by a postdigestion. Through a series of lab scale studies, gas production under mesophilic and thermophilic temperatures was compared. Furthermore, it was evaluated to what extent the digested residue resembled commercial compost. Thermophilic solid state fermentation markedly improved gas production while the digested residue qualified as a highly stabilized and hygienically acceptable compost. Encouraging results obtained in a pilot plant (55 m³) indicate the feasibility of large scale application of the process. The plant was first operated at 35°C, and subsequently at 55°C. Under the latter conditions, gas production attains a rate of 8 m³ biogas (55% CH_4)m³ reactor-day, for a loading of 21 kg COD/m³ reactor-day. 21 refs., 5 figs., 4 tabs.

7999 **Utilization of hydrolysate from acidic pretreatment of biomass in a mesophilic anaerobic fermentation system for the production of methane: Comparison of the standard CSTR with up-flow packed bed reactors.** Rivard, C.J.; Himmel, M.E.; Grohmann, K. (Solar Energy Research Institute, Golden, CO 80401). pp 375-385 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Acidic pretreatment of biomass under relatively mild conditions of dilute phosphoric acid and heat results in two streams, the partially hydrolyzed hemicellulosic sugars with organic acids and a lignocellulosic residue. Production of the gaseous fuel, methane, was investigated by comparison of fermentation performance using the standard, continuously stirred tank reactors (CSTR), and upflow packed bed reactors. The packed bed reactors function equally well at 5.3 times the dilution rate of the CSTR, require no stirring energy input and offer partial microbial protection against pH changes and oxygen intrusion. 13 refs., 6 figs., 1 tab.

8000 **Understanding natural and induced gas migration through landfill cover materials: The basis for improved landfill gas recovery.** Bogner, J.E. (Argonne National Lab., Argonne, IL 60439). pp 199-204 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Vertical pressure and concentration gradients in landfill cover materials are being examined at the Mallard North Landfill in Dupage County, Ill. The goal of this project is to understand venting of landfill gas and intrusion of atmospheric gases into the landfill in response to changing meteorological conditions (particularly barometric pressure and precipitation) and pumping rates at recovery wells. Nests of probes for directly measuring soil gas pres-

sures have been installed in areas of fractured and unfractured silty clay till cover materials. The probes are at three depths: shallow (0.6 m), intermediate (1.2 m), and deep (in the top of the refuse). Preliminary results from fall 1985 suggest that soil gas pressures respond quickly to changes in barometric pressure but that concentrations of methane, carbon dioxide, nitrogen, and oxygen respond more slowly to changing soil moisture conditions. An important near-surface process that limits the total amount of methane available to a gas recovery system is the activity of methanotrophs (methane-oxidizing bacteria) in oxygenated cover materials. The results of this project will be used to quantify landfill mass balance relations, improve existing predictive models for landfill gas recovery systems, and improve landfill cover design for sites where gas recovery is anticipated.

8001 **Microbiological conversion of renewable resources into liquid fuels.** Wyman, C.E. (Solar Energy Research Institute, Golden, CO 80401). pp 217-222 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Lignocellulosics include such materials as wood from short rotation forests, crop and forestry residues, and municipal solid wastes that are abundant, inexpensive, and renewable. Although the value of lignocellulosic materials as a solid fuel is limited by the price of their principal competitor, coal, biological conversion processes can directly transform the unique, complex structure of the lignocellulose into the most valuable fuels--substitutes for petroleum. In this paper, several processes are discussed that can enzymatically catalyze the hydrolysis of cellulose, the principal component of lignocellulosics, into glucose sugar and ferment the sugar into liquid fuel substitutes such as ethanol. Evaluations of the economics of enzymatic processes based on currently available technology are presented, and the relationship between the price of feedstock and the value of the fuel product is shown. Research opportunities are then defined to improve the biological-based conversion technology so that the cost of liquid fuels from renewables will be less than that of conventional fuels. Particular attention is focused on the need to reduce the cost of enzyme production for the process as well as to maximize the utilization of the lignocellulosic feedstock.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 8029, 8031, 8605, 8625

8002 **(DOE/PC/70022—T3) Optimum higher alcohol mixtures for fuels from syngas: Seventh quarterly technical progress report, April-June 1986.** (Union Carbide Corp., South Charleston, WV (USA). Research and Development Dept.). 30 Jul 1986. Contract AC22-84PC70022. 76p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87002452.

The objective of the contract is to develop and evaluate novel homogeneous catalytic systems for the selective conversion of low H_2/CO syngas to alcohol fuel extenders. Progress reports are presented for Task 1, modification of ruthenium catalyst system, and Task 3, further study of superior catalysts. As reported in the previous quarter, the use of a novel metal-containing additive, A38, in the catalytic system of ruthenium carbonyl/molten phosphonium salt causes the activity of the system to increase substantially. Even at the relatively low syngas pressure of 3000 psi, the activity of the system was quite respectable. We have now found that addition of the precursors of A38 to a ruthenium catalyst system gives similar, but slightly inferior results. The addition of organic additive A58 was found to enhance the production of C_2 products such as ethanol, and increased activities were also observed. Research in Task 3 has been conducted on the novel methanol homologation system which produces ethanol and other products under relatively low pressures. Studies of the catalyst chemistry have been carried out, with an emphasis on the involvement of catalyst precursors in the catalytic chemistry. The effects of using related and different catalyst precursors have been investigated, and these studies are continuing. 8 tabs. (AT)

8003 **(SERI/TR—232-2719) Summary report: Economic feasibility studies of alcohol fuel production processes.** Wright, J.D.; Milne, T.; Karpuk, M.E.; Isaacs, S.; Hoagland, W. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1986. Contract AC02-83CH10093. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87001106.

In 1983 SERI awarded six subcontracts to four engineering firms to conduct technical and economic feasibility studies of processes to convert lignocellulosic feedstocks into premium fuels (methanol and ethanol). In this report general conclusions are drawn about the status of alcohol fuels production from cellulosic feedstocks and detailed conclusions about the status, economics, research needs, and process steps. Stone and Webster Engineering Corp. studied the oxygen gasification route to methanol; Stone and Webster and Badger Engineers Inc. evaluated acid hydrolysis processes; Stone and Webster, Arthur D. Little Inc., and Chem Systems Inc. evaluated enzymatic hydrolysis processes. Methanol production is best understood and acid hydrolysis requires engineering development; both show near-term promise. Enzymatic hydrolysis still requires basic and applied research and could lower liquid fuel costs in the long term, potentially being the lowest. 15 refs., 7 figs., 19 tabs.

8004 **A process for cofermentation of whey and corn to produce industrial alcohol.** Whalen, P.J.; Shahani, K.M.; Lowry, S.R. (Univ. of Nebraska, Lincoln, NE 68583-0919). pp 117-128 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Whey permeate was utilized as the liquid portion of a corn mash and processed with a fungal α-amylase. A mixed inoculum of Kluyveromyces fragilis and Saccharomyces cerevisiae was employed. The simultaneous addition of the two yeasts resulted in only 7.95% ethanol (v/v); however, delaying the addition of the S. cerevisiae resulted in 9.75% ethanol in 72 h. Lactose utilization required a high K. fragils population. Due to the contribution of the lactose, the yield for the staggered method of the whey-corn cofermentation was equivalent to 3.63 gal/bu of corn processed versus the control (corn mash) at 2.63 gal/bu. 23 refs., 6 figs., 1 tab.

8005 **Effects of culture conditions on the fermentation of xylose to ethanol by Candida shehatae.** Jeffries, T.W. (US Department of Agriculture, Madison, WI 53705). pp 149-166 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

This research examined four factors on the fermentation of xylose by Candida shehatae, and the following conclusions were reached: (1) A minimal medium is effective for producing ethanol. (2) Peptone and casamino acids stimulate ethanol production. (3) Aeration is important in obtaining good ethanol production rates and yields. (4) The maximal rate of ethanol production is attained around pH 3.2 to 3.4. Under the best conditions employed, C. Shehatae ATCC 22984 produced up to 4% (w/v) ethanol from 20% xylose in four days. With 9% xylose, ethanol yields approximating 0.4 g/g xylose were obtained. 20 refs., 12 figs., 2 tabs.

8006 **Fermentation of xylose to ethanol by Candida shehatae.** Wayman, M.; Tsuyuki, S.T. (Univ. of Toronto, Ontario, Canada M5S 1A4). pp 167-177 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Ethanol fermentation of xylose by Candida shehatae in a semiaerobic mode at pH 5.0 and 30°C with 2 g/L inoculum produced 0.30 to 0.39 g ethanol/g xylose consumed, with xylose concentrations of 30 to 200 g/L. Peak ethanol concentrations were obtained

in 24 h at 30 g/L but required 72 h at 120 g/L. Oxygen concentration cycled between 8.4 and 0.7 ppM. Addition of estimated ethanol consumption by the yeast to measured ethanol production resulted in a calculated production rate of 0.38-0.45 g ethanol/g xylose consumed. Anaerobic fermentation was slower, being 73% complete in 70 h. Results with seven other promising yeasts are reported. 19 refs., 4 figs., 3 tabs.

8007 **Ethanol production in a membrane recycle bioreactor: Comparison of the performance of Saccharomyces cerevisiae and Zymomonas mobilis.** Khorakiwala, K.H.; Cheryan, M.; Mehaia, M.A. (Univ. of Illinois, Urbana, IL 61801). pp 249-261 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

A cell recycle bioreactor was designed using synthetic semipermeable hollow fiber membranes in a semi closed-loop configuration with a continuous stirred-tank reactor. The conversion of glucose to ethanol by a yeast (Saccharomyces cerevisiae) and a bacterium (Zymomonas mobilis) was a function of cell concentration and dilution rate. With 100 g/L glucose feed, yeast cell concentrations of 100 to 120 g/L resulted in ethanol productivities of 100 g/L/h with essentially complete glucose utilization. With Z.Mobilis, productivity was 45 to 55 g/L/h with 100 g/L glucose and 29 g/L/h with 150 g/L glucose. Maintaining stable long-term operation was more difficult with Z.mobilis, especially at cell concentrations above 50 g/L. Yeast appears to be the preferred organism in a membrane recycle bioreactor. 18 refs., 8 figs., 3 tabs.

8008 **Generalized characteristics of a cross-linked immobilized cell reactor for ethanol production.** Vega, J.L.; O'Malley, J.D.; Clausen, E.C.; Gaddy, J.L. (Univ. of Arkansas, Fayetteville, AK 72701). pp 263-276 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The performance of Saccharomyces cerevisiae immobilized by cross-linking with glutaraldehyde on a gelatin-coated support is presented. The influence of the inlet glucose concentration in the reactor at low level of nutrients (0.3% yeast extract) is analyzed and a maximum in productivity of 43 g/L h (based on liquid hold-up) is found between 150 and 200 g/L of glucose. By making use of a modified Monod model, values of cell concentrations working at the same production rate as in a cell-free batch system are obtained and compared. 9 refs., 8 figs., 3 tabs.

8009 **Factors affecting ethanol production from cheese whey.** Tu, C-W.; Jayanata, Y.; Bajpai, R. (Univ. of Missouri, Columbia, MO 65211). pp 295-305 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Fermentation of 25% whey solutions by Kluyveromyces marxianus CBS 397 were studied in shake flasks. Optimum pH value for the heat deproteinization of whey solutions was found to be 4.5. The temperature of deproteinization was not critical. The rates of ethanol production and lactose consumption in shake flasks were found to increase with increasing pH of broth up to 5.9. Differences in the observed fermentation patterns between two types of cheese wheys could be ascribed to the presence of monosaccharides. 14 refs., 12 figs.

8010 **Applications of aphron technology to biological separations.** Wallis, D.A.; Michelsen, D.L.; Sebba, F.; Carpenter, J.K.; Houle, D. (Virginia Polytechnic Institute and State Univ., Blackburg, VA 24061). pp 399-408 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The term "aphron" is defined as a distinct unit of fluid, encapsulated by a thin film of another fluid. Two types of very small (ca. 25 μm diameter) and highly stable aphrons, colloidal gas aphrons (CGA) and colloidal liquid aphrons (CLA), have been applied to a number of difficult separations. Using CGA floc-flotation, unicellular algae can be efficiently separated (85% recovery) and concentrated from dilute suspensions. Dispersed hydrophobic liquids can also be removed by CGA flotation, including CLA. The combination of CLA extraction/CGA flotation has been investigated for recovery of fermentation products (e.g., ethanol) and for extraction of very dilute solutes (10 to 20 ppM orthodichlorobenzene). CGA dispersions have also been investigated for improving the phase separation rates of aqueous two-phase extraction systems without decreasing mass transfer rates. 11 refs., 3 figs., 2 tabs.

8011 **Performance of a cell recycling continuous fermentation system for the production of n-butanol by Clostridium acetobutylicum.** Vijjeswarapu, W.K.; Chen, W.Y.; Foutch, G.L. (Oklahoma State Univ., Stillwater, OK 74078). pp 471-478 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

These experiments indicate that increased butanol production occurs in a continuous stirred tank reactor when cell recycle is used. Cell recycle with heat-shocking is required for this effect to be seen. The amount of increased butanol production for an unbalanced, non-optimized media was ca. 3.5 in these experiments. Further increase in butanol production would be expected with optimized media, better pH control, and continuous cell mass recycling. 12 refs., 2 figs., 3 tabs.

8012 **Concentrated halogen acid hydrolysis processes for alcohol fuel production.** Wright, J.D.; Power, A.J. (Solar Energy Research Institute, Golden, CO). pp 511-532 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

All the halogen acid processes work on the principle that concentrated acids decrystallize the cellulose, rendering it amorphous and easy to hydrolyze at temperatures where sugar degradation is unimportant. All processes have hydrolysis reactors that are both efficient and low in cost. However, in all cases the process economics are dominated by the cost and efficiency of acid recovery. While HCl liquid-phase processing is a commercially proven technology, the evaporation/distillation-based acid recovery system is quite expensive. For such a process to become practical, a new type of recovery system is necessary . The liquid-phase HF system shows some promise, but small changes in the efficiency of HF recovery greatly hurt the economics. Finally, gas-phase HCl processing has serious mechanical problems. 25 refs., 5 figs., 3 tabs.

8013 **Best available technology plant for conversion of cotton gin residues (cellulose wastes) to ethanol.** Clements, L.D.; Beck, S.R. (Univ. of Nebraska-Lincoln, Lincoln, NB 68588-0126; Texas Tech Univ. Lubbock TX 79409). pp 579-598 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Cotton gin residues are attractive as a biomass conversion feedstock because they are collected during harvesting. Computer design modules and laboratory results were used to compare the process options in conversion of cotoon gin residues to ethanol. The processing sequence which offered the lowest final ethanol cost was the nominated process. This nominated process was the basis for a detailed process design and cost estimation for a 3.785 x 10^6 L/yr (10^6 gal/year) plant. A larger capacity is necessary for an economical plant but the experimental and design program demonstrated the technical feasibility of the selected process. 11 refs., 11 figs., 12 tabs.

8014 **Evaluation of solvents for the recovery of Clostridium fermentation products by liquid-liquid extraction.** Dadgar, A.M.; Foutch, G.L. (Oklahoma State Univ., Stillwater, OK 74078). pp 611-620 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

Solvent extraction techniques have the potential for tremendous energy savings in the recovery of fermentation products. This research evaluated 47 solvents for their ability to recover Clostridium fermentation products. Equilibrium distribution coefficients for ethanol, butanol, and acetone have been experimentally determined. Separation factors for removal of these products from water have been calculated. Due to their nonpolar characteristics, aliphatic hydrocarbons are poor extractants. As the number of carbon molecules increase, hydrocarbon solvents become less effective for extraction. Substitution with halogen and nitrogen groups improve the distribution coefficients for hydrocarbons. Chlorinated aromatics give an incrementally higher separation factor. Aliphatic alcohols have excellent distribution coefficients with relatively moderate separation factors. However, they possess a high boiling point in the range 180 to 190°C and a high heat of vaporization. Ketones are excellent solvents due to ca. 20% density difference with respect to water, low to moderate boiling point, and average heats of vaporization. However, their solubility in water, flammability, and waste handling requirements should be carefully considered. Esters are similar to ketones, but have the additional problem of higher reactivity. 12 refs., 3 tabs.

8015 **Alcohol production by yeast fermentation and membrane extraction.** Frank, G.T.; Sirkar, K.K. (Stevens Institute of Technology, Castle Point, Hoboken, NJ 07030). pp 621-631 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

Successful commercialization of fermentation processes for low molecular weight primary or secondary metabolites requires optimal bioreactor performance and an efficient product recovery scheme. Immobilized biocatalyst reactors are widely recognized to be essential to optimal fermentation processes. It is also being increasingly realized that a simple, continuous, and efficient recovery of product in situ in the bioreactor will not only eliminate product toxicity, thereby increasing the process productivity, but also drastically reduce the cost currently incurred to recover the product from the broth with the cellular mass. This communication describes an integrated product recovery-cum-bioreactor based on an immobilized whole cell tubular reactor containing microporous hollow fiber membranes achieving simultaneous localized separation of the product by solvent extraction. 15 refs., 5 figs.

8016 **Off-line monitoring of fermentation samples by FTIR/ATR: A feasibility study for real-time process control.** Alberti, J.C.; Phillips, J.A.; Fink, D.J.; Wacasz, F.M. (Lehigh Univ., Bethlehem, PA 18015; Battelle-Columbus Labs., OH 43201-2693). pp 689-722 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

Experiments were run to determine the suitability of FTIR/ATR spectroscopy for monitoring substrate and product concentrations in fermentation broths. Infrared spectra of samples from a fed-batch Saccharomyces cerevisiae fermentation on defined media were obtained and concentrations of lumped media, glucose, ethanol, and glycerol estimated by four multivariate techniques to characterize the range of response that can be achieved with the FTIR/ATR probe. The probe accurately monitored substrate and product concentrations from 0.8 to 60 g/L despite the presence of water, microorganism, and major and trace media components. The influence of cell mass was shown to be negligible at low concentrations. 104 refs., 14 figs., 5 tabs.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 8029

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 8305

8017 **(IVO-B—06/86) Prospects of energy use of wood in terms of availability, economy and environmental impacts.** Miettinen, M.; Sahrman, K. (Imatran Voima Oy, Helsinki (Finland)). Apr 1986. 59p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750391.

The study deals with wood production and use of energy wood, and with the related environmental factors in Finland. The time span studied reaches beyond the turn of the millennium. That is why the effects of the techno-economic limitations during the span studied may change significantly resulting in considerable changes in the energy use of wood. Successful wood production calls for efficient forestry measures. Knowing and controlling the risks related to wood production is also most important. Variations in the nutrient balance and atmospheric pollution may be threats to the forestry. Concepts of acquisition, treatment and use of energy wood consisting of whole trees, pruned stems, logging residue, industrial waste wood and short rotation cultivation are assessed in terms of environmental impacts and costs. At present, the use of energy wood is competitive in the industrial processes, in small-scale heating, in big real estates, and in small real estates, when the own forest, for example, provides the fuel. In terms of wood reserves, an even considerable increase is realistic in the use of wood as fuel, in the wood processing industry as energy source and in other applications. Development of the acquisition, transport and firing techniques improves the competitiveness of wood in energy use. However, the price relation between industrial wood and energy wood, and the development of the industrial processes in future probably will direct the use of wood primary to raw material in industry.

8018 **(NP—7750366) Production of pellets from dry wood wastes.** (Statens Energiverk, Stockholm (Sweden)). 25 Jan 1985. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750366.

The report reviews technical, economic and marketing aspects on the production of pellets based on the wood materials in the industrial wastes. In the region of Stockholm almost 100% of such materials are reansported to refuse dumps. From a technical point of view the possibilities for the production are good, but it depends on the oil prices if it will be an economic affair.

8019 **(STEV-FBA—86-1) Conversion of combined burners to burning pellets.** Ravnsborg, J. (Statens Energiverk, Stockholm (Sweden)). Feb 1986. 56p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750343.

Two small boilers (for individual house heating) of multifuel type, i.e. alternatively oil or wood sticks has been converted to burn wood/bark-based pellets. The boilers were connected to heat storage accumulators and operated batchwise without any power control device - the door and the damper were in fixed positions. This report describes the development activities which ended up with the following ultimate version: An after-burn zone was established in the original fire-place. It was built as a rectangular duct of brickstone in the bottom of the fire-place and up along its inner wall. High turbulence was induced in the duct by a set of turbulators (flow restrictors) arranged in a special pattern. The air supply was split into separate zones, i.e. primary-, secondary- and tertiary air. The heating tests gave the following results: - Flue gas temperature of about 300 degrees with recently cleaned tubes. - O_2-concentration in the flue gas which increased gently from approximately 3% to 12% during the 'batch period' (time to burn down a full batch of pellets). CO-concentration of about 2000 ppm except for two characteristic periods with strong fluctuations and very high levels. Fairly reproducible measurement results for one and the same pellets shipment (some tons). However, the next delivery did quite often require readjustment and even remodification. Reliable function and easy to handle. Conclusively the project work including long-term heating showed that wood-based pellets is not a type of fuel which can be generally recommended for use in small boilers of the investigated types. The conversion and the operation of the converted units require measurement equipment and a skill which are not likely possessed by owners of dwelling houses.

13 HYDRO ENERGY

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 8594

8020 **(DOE/BP/21237—1) Juvenile radio-tag study: Lower Granite Dam. Annual report, 1985.** Stuehrenberg, L.C.; Giorgi, A.E.; Sims, C.W.; Ramonda-Powell, J.; Wilson, J. (National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.). Jun 1986. Contract AI79-85BP21237. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002221.

The concept of using mass releases of juvenile radio tags represents a new and potentially powerful research tool that could be effectively applied to juvenile salmonid passage problems at dams on the Columbia and Snake Rivers. A system of detector antennas, strategically located, would automatically detect and record individually tagged juvenile salmonids as they pass through the spillway, powerhouse, bypass system, or tailrace areas below the dam. Accurate measurements of spill effectiveness, fish guiding efficiency (FGE), collection efficiency (CE), spillway survival, powerhouse survival, and bypass survival would be possible without handling large numbers of unmarked fish. A prototype juvenile radio-tag system was developed and tested by the National Marine Fisheries Service (NMFS) and Bonneville Power Administration (BPA) at John Day Dam and at Lower Granite Dam. This report summarizes research to: (1) evaluate the effectiveness of the prototype juvenile radio-tag system in a field situation and (2) to test the basic assumptions inherent in using the juvenile radio tag as a research tool.

8021 **(DOE/BP/22493—1) Kokanee stock status and contribution of Cabinet Gorge Hatchery, Lake Pend Oreille, Idaho. Annual progress report, FY 1985.** Bowles, E.C.; Ellis, V.L.; Washick, D. (Idaho Dept. of Fish and Game, Boise (USA). Fisheries Research Section). Jul 1986. Contract AI79-85BP22493. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002222.

Mid-water trawling techniques were used during September to estimate kokanee population abundance, structure and survival. Abundance in 1985 was estimated at 4.5 million fish (198 per hectare), down from over 12 million kokanee in 1974 when the population was first monitored. Hatchery fry production (<6 million annually) has stabilized kokanee abundance since its initial decline in the late 1960s. Wild fry recruitment has remained relatively stable at 1.8 million since 1978; whereas recruitment of hatchery-reared fry has ranged from 0.09 to 1.98 million. The 1985 creel survey indicated that kokanee harvest rates remain low, with approximately one kokanee harvested per hour of effort from April to August. Catch rates were as high as 3.5 fish per hour during the mid-1960s. The zooplankton community was monitored with periodic plankton tows. Zooplankton composition in 1985 was similar to previous years and appears to have stabilized following the introduction of mysids, with peak cladoceran production occurring several weeks after peak kokanee emergence. Delayed release of hatchery fry resulted in higher survival of hatchery (7.3%) than wild (0.43%) kokanee fry. Other release strategies will be tested as more fry become available.

8022 **(DOE/BP/39643—1) Use of a fish transportation barge for increasing returns of steelhead imprinted for homing. Annual report, 1985.** Harmon, J.R.; Slatick, E. (National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.). Jun 1986. Contract AI79-83BP39643. 47p. NTIS, PC A03. File Number DE87002218.

A 6-year study to determine if transporting steelhead, Salmo gairdneri, smolts by barge from Dworshak National Fish Hatchery (NFH) to a release site on the Columbia River below Bonneville Dam would result in increased returns of adults to the various fisheries and to the hatchery homing sites is reported. During 1982 and 1983, over 500,000 juveniles were marked for the study. Adults have returned to in-river sampling sites, to the sport and Indian fisheries, and to the Dworshak NFH homing site from these groups of fish that were serially released as controls from the hatchery or barged as test fish to below Bonneville Dam. As of July 1985, most returns were from test and control groups released in the spring of 1982. Most returns from 1983 releases are expected during the 1985 and 1986 steelhead migration. Survival of both control and test fish released in late April and mid-May in 1982 was substantially higher than the survival of those released early (19 April) and late (31 May).

14 SOLAR ENERGY

1401 Resources And Availability

REFER ALSO TO CITATION(S) 8095

8023 (CONF-860641—, pp 276-281) **Solar radiation data handbook for Norway.** Olseth, J.A.; Skartveit, A. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

As part of the Norwegian national solar energy activity a handbook is produced in order to provide the Norwegian solar energy community with an easily usable data base in graphical form. The handbook compiles existing solar irradiance data, and it also makes use of the abundant observations of cloudiness. From these data the following information is derived and presented in graphical form for each calendar month and for the whole year: 1) Maps with isolines for mean global irradiance, 2) graphs showing expected cumulative duration and insolation of global irradiance below given thresholds, and 3) ratios between mean irradiance and mean global irradiance both for fixed slopes and for solar tracking surfaces.

8024 (CONF-860641—, pp 282-287) **Estimation of solar energy resource at high latitudes.** Saluja, G.S.; Muneer, T. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Daily and hourly correlations have been developed between global (total) and diffuse solar irradiation on a horizontal surface using 3-year hourly data for five widespread locations, covering 51degN - 60degN latitude range, in the UK. Statistical tests showed that the error distribution is symmetrical and that a large number of estimates fall within bands of small errors. The validity of existing inclined surface irradiation models was tested by employing one-year hourly data on four principal vertical surfaces for Easthampstead (51degN). This led to the development of a comprehensive and improved anisotropic model which distinguishes between shaded and sun-lit surfaces and between overcast and non-overcast conditions of sun-lit surfaces. The accuracy of the proposed model has been tested against short term measured data on vertical and inclined surfaces for four other locations in the UK including Lerwick (60degN). 13 refs.

8025 **(STEV-FVE—86-5) Measurement of solar radiation at SMHI.** Dahlgren, L. (Statens Energiverk, Stockholm (Sweden)). Aug 1986. 18p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750352.

The network for the measurement of solar radiation consists of 12 stations. The cost of the installation 1979/1980 was 9.225 MSEK. The operation of the stations has been continuous since 1983. Beside data acquisition there are data processing and publication of results. (G.B.).

8026 **(TKK-KO/ET—11) Model for the time average of distribution of sky radiance.** Siren, K. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1986. 115p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750397.

A model, describing the distribution of the radiance of scattered radiation, has been developed for the evaluation of the effects of scattered solar radiation in different building and energy technical applications. In the model the scattered radiation is divided into two parts, the circumsolar component radiating in the vicinity of the sun, and the isotropic component consisting of the whole sky dome. The isotropic component has a uniform-radiance. For the circumsolar component three alternative radiance distributions have been used. The features of the model can be presented by means of four parameters. To obtain the values of the parameters, measurements have been made with three horizontally installed pyranometers equipped with equatorial shadow bands. The bands used have the same diameter but different width. As a result of this, a different amount of scattered radiation reaches the pyranometers. Using the model, an equation is written for the radiation energy, measured by every pyranometer during the recording time. From these four equations, the four parameters of the model can be solved. The parameters calculated from the results of the measurements, correlate with the clearness index calculated from the total radiation. The goodness of the correlation depends on the length of the recording time of the samples and the used radiance distribution of the circumsolar component. On clear weather the circumsolar component is responsible for 30-50% of the whole emitted scattered radiation. On total overcast conditions only the isotropic component remains. The verification of the model has been done by simultaneous pyrameter and pyrheliometer measurements. The developed model shows its superiority to the isotropic approximation and seems to function under all kinds of sky conditions.

1403 Economics

REFER ALSO TO CITATION(S) 8063

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 7877, 7878, 8000, 8001, 8012, 8017, 8065, 8069, 8446, 8468, 8606, 8625

8027 **(SERI/STR—211-3045) Spectroscopic studies of hydrogenated amorphous silicon: Annual contract report, 15 March 1985-15 March 1986.** Bishop, S.G.; Carlos, W.E.; Strom, U. (Naval Research Lab., Washington, DC (USA)). Oct 1986. Contract AC02-83CH10093;AI02-80CS83116. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001108.

This annual report covers work on fundamental structural and electronic studies of hydrogenated films of Si and Si-Ge alloys and on characterizing such materials for other research groups. Specific objectives were (1) to compare light soaking experiments of films prepared by glow discharge and photochemical vapor deposition to gain information about the photoinduced defect density; (2) to perform nuclear magnetic resonance measurements on a sample grown by atmospheric pressure chemical vapor deposition for comparison; (3) to investigate the ESR and photoluminescence properties of doped a-Si:H superlattices to characterize the effect of substrate temperature on material quality; (4) to study Si/Ge alloys to identify the dominant electronic defect in these materials; and (5) to develop a sample/detector suitable for studying time-resolved, nonradiative processes in an a-Si:H film. Further study of this alloy film for different values of Ge content is recommended.

8028 **(SERI/STR—213-3063) Solar cell measurement standardization devices and procedures: Final subcontract report, April 1981.** Zafonte, L.; Downing, R.G.; Mueller, R.; Anspaugh, B.; Weiss, R.; Webster, R. (Jet Propulsion Lab., Pasadena, CA (USA)). Nov 1986. Contract AC02-83CH10093. 124p. NTIS, PC A06. File Number DE87001115.

This report quantitatively evaluates the spectral mismatch error for the reference cell method. The spectral mismatch error for various crystalline silicon test cell/reference cell combinations under several popular solar simulators is compared with the red/blue ratio method. The absolute spectral response of seven Jet Propulsion Laboratory (JPL) block 4 modules was measured using a modified LAPSS model solar simulator. The spectral mismatch error for these modules using reference cells of a similar type under the JPL LAPSS varied from +1.0% to -1.3%.

8029 **(STEV-BF—86-6-Pt.1) Results from MINO-pilot S, stage 4. Part 1.** Blackadder, W.; Rensfelt, E.; Waldheim, L. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Apr 1986. 140p. (In Swedish). (STUDSVIK-EP—86-4). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750356.

The project MINO-pilot S has run in four phases; Phase 1 was an evaluation of existing technology and data for gasification of wood and peat with emphasis on production of synthesis gas. Phase 2 consisted of the design and construction of the MINO-pilot plant at Studsvik. The pilot unit has 500 kg DS/hr capability and gasifies the fuel in a 1.0-3.0 MPa oxygen blown fluidized bed gasifier followed by a high temperature filter and a catalytic secondary reformer for tar and methane conversion. Phase 3 was the first operational phase on wood and peat. Runs were performed at 1.0 MPa. Phase 4 consisted of additional operation, now mainly at 2.0-3.0 MPa. In parallel a feasibility study for the production of methanol or ammonia from peat at a 1000 ton/day level has been performed. This report covers the runs in the pilot unit during phase 4 (1985-01-01 to 1986-03-30). During this phase several runs were made on sod peat on behalf of Kemira Fertilizer OY in Finland to generate design data for a joint Studsvik/Linde TVT AG lumpsum proposal for a retrofit of the oil partial oxidation units in runs on East German lignite are reported and two runs on wood using an inert sand bed in the gasifier. In general the runs reported proves that the MINO process can yield low levels of tar but also of methane with all the fuels tested, that is wood, sod peat and lignite. With peat and lignite corrosion occurred in the metallic high temperature filter. This problem has been overcome by using a ceramic filter, a solution which was put to the test during the last run on lignite.

8030 **(STEV-EO—86-6) Large scale trial Storfoersoek Nord, cultivation of energy forests in the north of Sweden.** Andersson, G. (Statens Energiverk, Stockholm (Sweden)). 1986. 17p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750355.

The large scale trial 'Storfoersoek Nord' has studied cultivation of energy forests in northern Sweden. The main part of the trial has involved cultivation of broadleaf species specially birch and alder in extensive forms. Three areas near Umeaa has been chosen for the trial, Vaennaesby/Spoeland, Bullmyran and the

Runway area. As the trials have been stopped at an early stage, cultivation has been made only at Vaennaes/Spoeland (abandoned agriculture land) and Bullmyran (ditched marshland). 26 hectares has been planted. Results about possible yield can be obtained in about 15 years. The following observations has been made during the planting. The drainage of abandoned agriculture land must often be improved. Bad damages of voles are probable. Therefore planting should be done immediately after the culmination of vole population. The birch seedlings should be at least 40 cm in length at planting. Further studies about type of seedling and size should be done. Grazing from moose is probable in the birchlands. The area at Vaennaes/Spoeland may be of importance for the future use of abandoned agriculture land. The area of Bullmyran will show natural regeneration of drained marshland.

8031 **Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals.** Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). 732p. (CONF-850513—). John Wiley and Sons, Inc., 605 Third Ave., New York, NY 10158. File Number TI86013553. Contract AC05-84OR21400.

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Today, exciting new concepts for bioprocessing are being developed for fuel and chemical production. The Seventh Symposium on Biotechnology for Fuels and Chemicals, a forum established for the presentation and exchange of scientific and technical information in this area addressed the new developments. Several new approaches were introduced, and lively discussions ensued in areas as diverse as microbial liquefaction of coal and photosynthetic processes. The special topic of the meeting was a consideration of future trends in biotechnology.

8032 **Global Biotechnology: Prospects and problems.** Gaden, E.L. Jr. (Univ. of Virginia, Charlottesville, VA 22901). pp ix-xxi of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Biotechnology offers an exceptional range of opportunities for developing nations. These rest for the most part on the availability of a wide variety of renewable, that is "biomass," resources. Many now exist, and many others can be cultivated in the Third World, often in areas now severely battered by adverse climatic conditions. Furthermore, biotechnology offers developing countries attractive options for decentralized manufacturing activities compatible with their economic needs and traditional social structures. Even more important in the long term is the possibility that biotechnology can provide incentives for people in these areas to generate their schemes for value-adding activities. 11 refs.

8033 **Improved hemicellulose recovery from wheat straw.** Cunningham, R.L.; Carr, M.E.; Bagby, M.O. (US Department of Agriculture, Peoria, IL 61604). pp 17-26 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Wheat straw (WS) was chemically treated under various conditions to remove hemicellulose (pentosans) and lignin as water-soluble materials and to increase accessibility of its cellulose to enzymatic hydrolysis. Sodium hypochlorite, sodium hydroxide, and sulfuric acid were used alone and in selected combinations and sequences. A hypochlorite treatment of chopped WS with 15% available Cl_2 (dry WS basis) for 3 h at 55°C selectively removed 15% of the WS lignin and gave a fivefold increase in accessibility of its cellulose. Treatment of WS with a 10% solution of NaOH for 24 h at 25°C followed by dilute acid treatment for 3 h at 98°C provided fractions of pentosans (alkali extraction), xylose (acid treatment), cellulose (water-insoluble residue), and lignin (soluble). The cellulose was essentially all converted to glucose by enzymatic hydrolysis. One of the most effective treatments for removing pentosans from milled WS was an extraction with 12% NaOH solution for 4 h at 80°C. This removed 88% of the WS pentosans, of which 85% was recovered by acidified-alcohol precipitation. The WS cellulose from the latter treatment was nearly quantitatively converted to glucose by enzymatic hydrolysis. 22 refs., 2 figs., 4 tabs.

8034 **Some factors influencing the rate of cellulose hydrolysis by concentrated acids.** Bayat-Makooi, F.; Singh, T.M.; Goldstein, I.S. (North Carolina State Univ., Raleigh, NC 27695-8005). pp 27-37 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Hydrolysis of cellulose by concentrated acids involves a decrystallization step that forms a gel. This gel may inhibit complete hydrolysis by preventing further penetration of acid into unswollen regions of the cellulose. Cold acid impregnation of cellulose prior to hydrolysis significantly reduces this inhibiting effect. Posthydrolysis with dilute acid liberates glucose from cellulose hydrolysis residues. This additional glucose results in part from hydrolysis of soluble sugars condensed on the residual cellulose during hydrolysis. The removal of soluble sugars from solution by condensation on cellulose has implications for the accuracy of previously determined hydrolysis rates. 7 refs., 4 figs., 2 tabs.

8035 **Comminution of biomass: Hammer and knife mills.** Himmel, M.; Tucker, M.; Baker, J.; Rivard, C.; Oh, K.; Grohmann, K. (Solar Energy Research Institute, Golden, CO 80401). pp 39-58 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

For meaningful evaluation of process designs in biomass conversion, information is required concerning the cost of feedstock preparation for the process flowsheet of interest. In bioconversion processes designed for the production of fuels from biomass, the cost of performing secondary milling to very fine particles (e.g., 80 mesh and finer) soon emerges as a limiting factor due to the high power consumption and relatively low value of the end product. Literature review indicates that information covering milling of biomass to particles coarser than 80 mesh is not readily available. Therefore, aspen chips, corn stover, corn cobs, and wheat straw were subjected to analytical grinding studies using hammer and knife mills equipped with similar motors and rotor chamber volumes. Power consumption studies were performed as a function of feedstock, rejection screen size, and feed rate. The effects of gavity and pneumatic discharge were also examined. All mill products were characterized for particle size distribution. 20 refs., 11 figs.

8036 **Optimization of dilute acid pretreatment of biomass.** Grohmann, K.; Torget, R.; Himmel, M. (Solar Energy Research Institute, Golden, CO 80401). pp 59-80 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Lignocellulosic biomass in its native form is quite resistant to enzymatic attack. We have, therefore, investigated the kinetic parameters of the pretreatment of wheat straw and aspen wood, catalyzed by 0.5% sulfuric acid at a pH of 1.5 and a temperature range between 95 and 160°C. The results clearly indicate that removal of hemicelluloses by pretreatment is a necessary prerequisite for high enzymatic digestibility of cellulose for the two biomass substrates investigated. Lignin removal does not seem to be necessary. Kinetic data on hydrolysis of xylan backbones in wheat straw and aspen hemicelluloses indicate that two fractions fo xylan bonds exist at lower temperatures (95 to 140°C) which vary greatly in rate and

activation energy during dilute acid hydrolysis. 59 refs., 7 figs., 6 tabs.

8037 **Hydrolysis of hemicellulose by solid superacid.** Kim, S.B.; Lee, Y.Y. (Auburn Univ., Auburn, AL 36849). pp 81-90 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The kinetics of secondary hydrolysis of hemicellulose prehydrolyzate by a solid superacid, Nafion, was investigated. The Nafion catalyzed hydrolysis was found to be a first order reaction. The activation energy of the hydrolytic reaction was 30,200 cal/g-mol, not significantly different from that of free acid hydrolysis. The catalytic activity of Nafion determined from continuous column reactor operation was such that a near complete conversion of prehydrolyzate to monomer was achieved within 3 min of residence time at 130°C, and 10 min at 120°C. At reaction temperatures above 130°C the effect of diffusion became significant. Nafion appears to be a stable hydrolytic catalyst provided that the feed solution is free of cationic substances. 12 refs., 8 figs., 1 tab.

8038 **Enzymatic hydrolysis of carboxmethyl celluloses with varying degrees of substitution.** Dominguez, G.C.; Engler, C.R.; Soltes, E.J. (Texas A and M Univ., College Station, TX 77843-2135). pp 99-106 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

This study showed that carboxmethylation of cellulose at low levels of methylation significantly enhances initial rates of enzymatic hydrolysis and increases yields of both reducing sugars and glucose. Although carboxmethylation reaction conditions have not been optimized for glucose yield, it appears that conditions that enhance penetration of reagents into the cellulose structure but keep the rate of reaction relatively slow are required. Therefore, it is expected that carbonymethyl cellulose prepared at room temperature with continuous agitation and using lower chloroacetic acid and sodium hydroxide concentrations should give a high glucose yield. 13 refs., 5 figs., 1 tab.

8039 **Characterization of acid-precipitable, polymeric lignin (APPL) produced by Streptomyces viridosporus and protoplast fusion recombinant Streptomyces strains.** Pettey, T.M.; Crawford, D.L. (Univ. of Idaho, Moscow, ID 83843). pp 179-190 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Acid-precipitable, polymeric lignin (APPL) is an intermediate of lignin degradation by Streptomyces. In this study APPLs produced from corn lignocellulose by four APPL-overproducing protoplast fusion recombinant Streptomyces were chemically characterized and compared to APPLs produced by Streptomyces viridosporus T7A. Cultures were also compared for degradation of a [^{14}C]lignin lignocellulose. Recombinant strain APPLs were chemically distinct from S. viridosporus APPL. They showed a higher degrees of polymerization and less propane side chain modification. Recombinants also degraded [^{14}C]lignin to $^{14}CO_2$ more slowly than did S. viridosporus, and they produced higher levels of a β-etherase complex thought to be involved in APPL production. 19 refs., 2 figs., 7 tabs.

8040 **Properties of the cellulolytic enzyme system of Clostridium thermocellum.** Hon-Nami, K.; Coughlan, M.P.; Hon-Nami, H.; Carreira, L.H.; Ljungdahl, L.G. (Univ. of Georgia, Athens, GA 30602). pp 191-205 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Clostridium thermocellum growing on cellulose produces an extracellular cellulolytic system and a yellow affinity substance (YAS). The latter binds to the cellulose and facilitates adherence of the cellulase to the substrate. At early stages of growth most of the cellulase is bound to the YAS-cellulose but is gradually released to the medium. The bound enzyme consists of two major complexes of different sizes. The free enzyme is composed of two major fractions; one can rebind to YAS-cellulose, the other does not. All four fractions exhibit CMCase activity, but only the bound and the free rebindable complexes extensively solubilize crystalline cellulose. 32 refs., 6 figs., 2 tabs.

8041 **Comparison of three thermophilic acetogenic bacteria for production of calcium-magnesium acetate.** Ljungdahl, L.G.; Carreira, L.H.; Garrison, R.J.; Rabek, N.E.; Wiegel, J. (Univ. of Georgia, Athens, GA 30602). pp 207-223 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Clostridium thermoaceticum, Clostridium thermoautotrophicum, and Acetogenium kivui have been evaluated for the production of Ca-Mg acetate, which is an environmentally safe road deicer. Bacterial properties compared were range for pH and temperature; tolerance for glucose, acetate, Ca^{2+}, Mg^{2+}, and dolime (Ca, Mg carbonate). A. kivui grows faster than the two Clostridia but is less tolerant to glucose, acetate, Ca^{2+}, Mg^{2+}, and dolime. The production rates of acetate in continuous cultures with cell recycling were for A. kivui 4.8 g acetate/L h using a retention time of 1 h and for C. thermoaceticum and C. thermoautotrophicum 4 and 3.8 g acetate/L h, respectively, with a retention time of 4 h. The acetate concentrations reached 75, 300, and 250mM, respectively. 19 refs., 8 figs., 4 tabs.

8042 **Kinetics and models for the bioconversion of methane into an intracellular polymer, poly-β-hydroxybutyrate (PHB).** Asenjo, J.A.; Suk, J.S. (Columbia Univ., New York, NY 10027). pp 225-234 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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The use of mathematical models for growth and intracellular poly-β-hydroxybutyrate (PHB) accumulation in methanotrophs was investigated. The use of moderate pressure (up to 10 atm) shows significant promise for the acquisition of high cell mass concentrations and increased productivity. Several models developed for intracellular non-growth-associated product accumulation fitted our initial experimental data well. The most appropriate one, on a conceptual basis, appears to be the asymptotic model including a term for nitrogen inhibition. Conditions for PHB accumulation include N limitation and an adequate supply of CH_4 and O_2 throughout the fermentation. PHB levels also appear to be increased by inoculum conditions, an effect that should be investigated in more detail. 19 refs., 5 figs., 2 tabs.

8043 **Propionic acid production by bacterial fermentation.** Hendricks, B.; Korus, R.A.; Heimsch, R.C. (Univ. of Idaho, Moscow, ID 83843). pp 241-245 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Propionic acid is produced by the anaerobic fermentation of a wide variety of carbon sources by Propionibacterium species. P. acidi-propionici has been previously examined for the conversion of xylose and glucose to propionic and acetic acid. The growth of P. shermanii has been observed to follow Monod kinetics with propionic acid inhibition with K/sub p/ = 1.1 x 10^{-2}M, and acetic acid does not significantly inhibit growth of P. shermanii. The objective of this study was to characterize growth and acid production of two Priopionibacterium species in batch fermentations using a potato derived medium. 6 refs., 2 figs., 1 tab.

8044 **Enzymatic hydrolysis of cellulosic substances in an attrition bioreactor.** Deeble, M.F.; Lee, J.M. (Washington State Univ., Pullman, WA 99163). pp 277-293 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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The rate at which newsprint was hydrolyzed in an attrition bioreactor (ABR) was significantly enhanced compared to the rate achieved in a regular stirred reactor. Regardless of the ball diameter, height of milling media, or impeller type and speed, the conversion was function of the energy consumption. The power consumption in an ABR was linearly proportional to the impeller speed. The enhanced conversion of cellulose in an ABR may be due to a combination of factors, including the reduction in crystallinity, the increase in pore volume and durface area, and the increase in the accessibility of glucosidic bond sites to the cellulas complex. The cellulose enzyme was deactivated in an ABr but could be stabilized by the addition of a surfactant, Triton X-100. 16 refs., 15 figs.

8045 **Enhanced growth of Thiobacillus ferrooxidans in an eletrolytic bioreactor.** Yunker, S.B.; Radovich, J.M. (Univ., of Oklahoma, Norman, OK 73019). pp 307-319 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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The widespread use of microbes in coal desulfurization and bioleaching processes is limited by inadequate, in situ cell densities. Classical means of cultivating Thiobacillus ferroxidans, which is the bacterium most studied for use in microbial desulfurization and leaching, do not give dense cell populations in broth cultures. A novel reactor design for cultivation of this autotroph under electrolytic conditions is described. The bacterium oxidizes Fe^{2+} to Fe^{3+} while the Fe^{3+} is reduced to Fe^{2+} at the cathode in the electrolytic bioreactor. Preliminary studies indicated that cultivation at pH 1.6 and 29°C gave the optimum performance of the electrolytic bioreactor for cultivation of T. ferrooxidans. The ability to continually replenish the bacteria's substrate in a synthetic medium containing ferrous sulfate via an applied current resulted in significant increases in cell numbers, as well as increased yield coefficients (cellular efficiencies) and protein production rates (growth rates). The electrolytic bioreactor was shown to ba a feasible means of cultivating T. ferrooxidans and should be considered for microbial leaching/desulfurization processes. 29 refs., 3 figs., 3 tabs.

8046 **Photoautotrophic bioreactor using visible solar rays condensed by fresnel lenses and transmitted through optical fibers.** Mori, K. (Keio Univ., Yokohama 223, Japan). pp 331-345 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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A microalgal photoautotrophic bioreactor was constructed incorporating a multitude of fiber-optic light radiators within the tank to provide 5800 cm^2 radiative surface/L algal suspension, allowing biomass growth rates of 8%/h at high densities of 4.0 to 5.0 g/L. The sun was used as the main light source and xenon lamps were used as a supplement. Chromatic aberration in Fresnel lenses removed much of the infrared and ultraviolet wavelengths from the light as it was focused into fiber-optic cables for transmission to the remotely located bioreactor tank. The diminution of heat radiation allowed many well-distributed radiators to be placed in the tank without heating difficulties so that uniform light dissemination was possible. Chlorella pyrenoidosa was used for experimentation. 28 refs., 9 figs., 2 tabs.

8047 **Cellobiose hydrolysis by an immobilized yeast β-1,4-glucosidase.** Rohrbach, R.P.; Scherl, D.S.; Detroy, R.W.; Freer, S.N. (Signal Research Center, Des Plaines, IL 60016; US Department of Agriculture, Peoria, IL 61604). pp 363-374 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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A unique β-glucosidase identified from Candida wickerhamii was immobilized, characterized, and performance studied in a bioreactor using cellobiose and soluble cellodextrins as substrates. This enzyme not only has the capacity to hydrolyze cellobiose to glucose but also higher oligomers of cellobiose up to DP7 as well. Upon immobilization the enzyme retained a significant amount of activity essential for economic utility. The immobilized enzyme is able to hydrolyze cellobiose and soluble cellodextrins to glucose similar to the soluble enzyme. 13 refs., 8 figs., 2 tabs.

8048 **Chemithermomechanical pulp as a substrate for cellulase production.** Chahal, D.S.; Ishaque, M.; Chahal, P.S.; Lemay, J.; Lo, S.N.; Valade, J.L. (Institute Armand-Frappier, Laval-des-Rapides (Quebec) Canada H7V 1B7; Universite du Quebec a Trois-Rivers). pp 387-397 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Cellulase yield (IU/g cellulose) from Trichoderma reesei QMY-1, when grown on chemithermomechanical pulp (CTMP), was very high as compared to that obtained by other researchers from T. reesei Rut-C30 (a hypercellulase mutant) on various lignocellulosic substrates. The CTMP proved to be a good substrate for cellulase production. However, substrate concentrations more than 2% in conventional fermenter formed a thick slurry and caused a major problem for cellulase production due to poor mixing. Solid-state fermentation seems to be the answer to overcome such difficulties. 17 refs., 5 figs., 2 tabs.

8049 **Enzyme recycling in cellulose hydrolysis by combined use of aqueous two-phase systems and ultrafiltration.** Tjerneld, F.; Persson, I.; Albertsson, P.A.; Hahn-Haegerdal, B.H. (Univ. of Lund, S-221 00 Lund, Sweden). pp 419-429 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Cellulose (Solka Floc BW 200) was semicontinuously enzymatically hydrolyzed over a period of 1200 h in an aqueous two-phase system based on crude dextran and polyethylene glycol. The sugars were recovered from the top phase after phase separation using an ultrafiltration membrane unit. Enzymes and phase forming polymers were recycled. Cellulose was added intermittently to keep a constant concentration of ca. 80 g/L in the phase system. The dilution rate was adjusted so that an average sugar concentration of

74 g/L was maintained in the permeate. The degree of conversion of added substrate was 94%. The enzymes were added at the beginning of the hydrolysis and no further additions of enzymes were made. The enzyme consumption was 8.7 FPU/g reducing sugar (RS) produced, compared to 34.6 FPU/g RS in a batch process, which corresponds to a recovery of enzymes of 75%. 17 refs., 6 figs., 2 tabs.

8050 **Determination of the steady-state behavior of immobilized β-galactosidase utilizing an integral reactor scheme.** Scott, T.C.; Hill, C.G. Jr.; Amundson, C.H. (Oak Ridge National Lab., Oak Ridge, TN 37831; Univ. of Wisconsin, Madison, WI 53706). pp 431-445 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Analysis of the steady-state behavior of immobilized β-galactosidase by integral reactor techniques has yielded a model which allows one to predict performance under normal operating conditions. Values of the mechanistic rate constants for enzymatic hydrolysis of lactose were determined as a function of temperature by fitting the reactor model to experimental lactose conversion profiles. This model can be coupled with a knowledge of the activity decay characteristics of the immobilized enzyme to determine appropriate operating strategies for industrial applications of the immobilized enzyme catalyst. 18 refs., 5 figs., 6 tabs.

8051 **Saccharification of agricultural residues by combined cellulolytc and pectinolytic enzyme systems.** Coughlan, M.P.; Mehra, R.K.; Considine, P.J.; O'Rorke, A.; Puls, J. (Univ. College, Galway, Ireland; Federal Research Center of Forestry and Forest Products, Hanburg, West Germany). pp 447-458 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Extracts of solid-state cultures of Talaromyces emersonii UCG208, Trichoderma reesei QM9414, Trichoderma reesei MCG77, or commercial cellulase preparations catalyze extensive saccharification of beet pulp when reaction mixtures are supplemented with pectinase preparation. The key enzyme in the supplement appears to be pectinesterase. By contrast with the above, extracts of solid-state cultures of Penicillium capsulatum effect extensive solubilization of pulp without the need for supplementation. Under suitable conditions, close to quantitative hydrolysis can be achieved. 20 refs., 5 figs., 2 tabs.

8052 **Synthesis of extracellular proteins and intracellular L-lysine by baker's yeast growing on amylase-treated potato slices.** Park, D.H.; Hong, K.; Tanner, R.D.; Malaney, G.W. (Vanderbilt Univ., Nashville, TN 37235). pp 459-469 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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In previous studies of the basic principles of solid and semisolid fermentation processes, the growth of Saccharomyces cerevisiae has been compared during conventional batch submerged culture with growth of the yeast on semisolid artificial culture media. In addition to monitoring cell growth, other parameters such as the pH, L-lysine and extracellular protein production were also measured. This study of the growth of Saccharomyces cerevisiae on a solid natural substance, the starch in sliced potato, cotreated with α-amylase, is an extension of the previous work with an emphasis on the production of L-lysine and extracellular proteins. 13 refs., 7 figs.

8053 **Cellulase production from soybean seed coat: Study of culture conditions through response surface methodology.** Srivastava, K.C.; Dasilva, R.S.S.F. (State Univ. of Londrina, Parana, Brazil). pp 491-499 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Based on the data presented on the amount of oligosaccharides present in the soybean seed coat together with the constraints of its abundant availability, socio-economic impacts due to use of available food, feed, and land for the production of fuel ethanol; this feedstock warrants a more detailed study for its utilization as a renewable biomass raw material for both cellulase and ethanol production. 38 refs., 5 tabs.

8054 **A process for the production of polysaccharides from microalgae.** Anderson, D.B.; Eakin, D.E. (Battelle Pacific Northwest Labs., Richland, WA 99352). pp 533-547 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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A pilot plant was developed and operated for the production of polysaccharide from Porphyridium cruentum, a marine microalga. The pilot plant included a unique culture system design and processing operations for the recovery of the algal polysaccharide. Data on polysaccharide productivity and polysaccharide processing were collected over a five-month period. An economic analysis was completed for a plant size of 2000 metric tons/yr. Unit production costs were estimated microbial polysaccharide with an estimated market of 20,000 metric tons/yr. 17 refs., 6 figs., 4 tabs.

8055 **Anaerobic digestion of cellulosic wastes.** Lee, D.D.; Donaldson, T.L. (Oak Ridge National Lab., Oak Ridge TN 37831). pp 549-560 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Anaerobic digestion is a potentially attractive technology for volume reduction of low-level radioactive cellulosic wastes. A substantial fraction of the waste is converted to off-gas and a relatively small volume of biologically stabilized sludge is produced. Process development work has been completed using a 75-L digester to verify rates and conversions obtained at the bench scale. Startup and operating procedures have been developed, and effluent was generated for characterization and disposal studies. Three runs using batch and fed-batch conditions were made lasting 36, 90, and 423 days. Solids solubilization rates and gas production rates averaged approximately 1.8 g cellulose/L reactor/day and 1.2 L of off-gas/L reactor/day. Greater than 80% destruction of the volatile suspended solids was obtained. A simple dynamic process model was constructed to aid in process design and for use in process monitoring and control of a large-scale digester. 11 refs., 7 figs., 2 tabs.

8056 **Production of furfural from corn stover hemicellulose.** Sproull, R.S.; Bienkowski, P.R.; Tsao, G.T. (Purdue Univ., West Lafayette, IN 47904). pp 561-577 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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Furfural can be produced by dehydrating the pentoses obtained from the hydrolysis of hemicellulose in corn stover. However, furfural rapidly polymerizes under the high temperature acidic conditions necessary for its formation. High yields of furfural can

be obtained by carrying out the aqueous phase furfural-producing reactions in the presence of an immiscible solvent such as o-nitrotoluene. An economic analysis of this simple process, which includes recovery of the furfural by distillation and subsequent recycle of the solvent, indicates that furfural can be produced for about half its current selling price. 24 refs., 7 figs., 9 tabs.

8057 **Thermophilic anaerobic treatment of an industrial wastewater: Startup and stability studies.** Vicent, T.; Paris, J.M.; Lema, J.M.; Ibanez, E. (Univ. Autonoma de Barcelona, Bellaterra (Barcelona, Spain). pp 599-609 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

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The thermophilic operation of an anaerobic digester has been found to offer several advantages in comparison with a mesophilic one, e.g., higher reaction rate, better performance, and effective pathogens removal. It is particularly suitable when treating some medium and high strength wastewaters, which are discharged at high temperatures. However, some drawbacks, like higher energy requirements, sensitivity to toxicants and changes in environmental conditions, have caused the thermophilic operation to be rarely used. It has also been emphasized that the process instability can be related to the startup conditions, e.g., temperature acclimation, inoculum source, and loading rate. Therefore, a suitable inoculum and startup procedure have to be applied in order to ensure an efficient and stable operation. The objective of this work was to study the startup and performance of an anaerobic contact process treating food industry wastewater. Results are reported on the inoculum selection and startup procedure, as well as on the transient behavior of the operation due to temperature or loading rate shocks. 13 refs., 6 figs., 2 tabs.

8058 **Application of cell recycle to continuous fermentation acetic acid production.** Reed, W.M.; Bogdan, M.E. (Moffett Technical Cen., Summit-Argo, IL 60501). pp 641-647 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

A reduction in fermentor size and cost can be achieved by increasing volumetric productivity. The volumetric productivity of a fermentor is directly related to the amount of biocatalyst present. The concentration of an intracellular biocatalyst can be increased by retaining the microorganism in the fermentor. One way of accomplishing cell retention is cell recycle using cross-flow filtration. Volumetric productivity gains as great as tenfold have been achieved in continuous bacterial fermentation systems using cross-flow filtration/cell recycle. This type of cell recycle has been applied to aerobic and anaerobic bacteria. However, this technique has never been applied to strict obligate anaerobes such as Clostridium thermoaceticum. 9 refs., 7 figs.

8059 **Leaching: A separation process for the production of fuels and chemicals from biomass.** Ladisch, M.R.; Tsao, G.T.; Lin, J.K. (Purdue Univ., West Lafayette, IN 47907). pp 723-736 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

The application of biotechnology to the production of fuels and chemicals from biomass must include consideration of separation processes. One objective is to recover products of biomass processing in a concentrated form, if possible. The ability of biomass to absorb water will result in low fermentable sugar concentrations. A low moisture hydrolysis, coupled with leaching, can give fermentable sugar concentrations above 15%, and hence, circumvents this problem. Calculations required to design a sugar recovery process in an systematic manner are outlined. 42 refs., 1 figs., 3 tabs.

8060 **Cost analysis of alternate biomass supply systems.** Strauss, C.H.; Blankenhorn, P.R.; Bowersox, T.W.; Grado, S.C. (School of Forest Resources, The Pennsylvania State Univ., University Park, PA 16802). pp 193-198 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A series of short rotation Populus plantations were financially evaluated as biomass production centers. The plantation used Populus hybrid NE-388, a tree spacing of 0.6 m x 0.8 and a first rotation length of 4 years. Four plantation strategies (control, irrigation, fertilization, and fertilization-irrigation) were employed on favorable and unfavorable growing sites. The proposed size for a commercial unit was 924 hectares, with 4 such units operated as a sustained supply system. Alternate harvesting and storage strategies were linked to the plantation strategies in determining the least cost approach for supplying biomass to a conversion center. All aspects of the biomass supply system were cost analyzed on a commercial scale basis. The control strategy on the better site had the least expensive production cost, at $28.71 per ovendry tonne. The least cost approach for supplying biomass to an ethanol processing center involved the control strategy, a harvest/baling strategy and wet storage for a total supply cost of $59.57/ODt. This supply cost for a large scale ethanol plant.

8061 **An overview of biomass thermochemical liquefaction research sponsored by the U.S. Department of Energy.** Stevens, D.J. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 213-216 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC06-76RL01830.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Biomass is an important energy resource at present and offers excellent potential for increased energy impact in the future. This potential energy impact is expected to be met in part by liquid fuels derived from biomass. Liquid fuels are more energy dense than biomass itself and more closely match existing end-use patterns. In this paper, research sponsored by the U.S. Department of Energy's Biomass Energy Technology Division on the direct thermochemical conversion of biomass to liquid fuels is discussed. Both the conversion of biomass to biocrude oil and subsequent product upgrading to hydrocarbon-compatible fuels are addressed.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 8276

8062 **(SAND—85-7018/2) Evaluation of international photovoltaic projects: Volume II, Technical report.** Eskenazi, D.; Kerner, D.; Slominski, L. (Meridian Corp., Falls Church, VA (USA)). Sep 1986. Contract AC04-76DP00789. 348p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87002993.

This report provides a comprehensive review and financial analysis of photovoltaic power systems for remote applications in developing countries. Volume I, the Executive Summary, provides an overview of all findings; Volume II, the Technical Report, covers the methods of analysis used and the results obtained. Five application areas are included: water pumping, communications, vaccine refrigeration, lighting and home power, and multi-use systems. Findings are based on qualitative reviews of more than 2700 systems in 45 countries. Information was collected from published reports, questionnaires, and interviews with key experts. Site visits were not within the scope of this evaluation. The intended audience of this report are development agency officials, manufacturers, and users. Based on "lessons learned" from past projects, recommendations are provided for project implementation. In addition, financial analyses allow decision makers to use their own assumptions to

obtain a first-order indication of the financial attractiveness of photovoltaic systems for each application. This report also provides industry with an assessment of product performance and suggested areas for additional improvements.

8063 **Status of the Federal Photovoltaic Research Program.** Krantz, A.D. (U.S. Dept. of Energy, Washington, DC 20585). pp 1259-1260 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Photovoltaic cells have been used for spacecraft for over twenty five years. The Federal Photovoltaic Research Program which is attempting to develop this technology for terrestrial application is starting its second decade. Since 1975 the government has invested over $800 million in an effort to develop a clean, safe, power generation option that is technically and economically competitive with present and future U.S. grid power. Analysis shows that massive implementation, in the order of tens of gigawatts will occur when photovoltaic electricity cost will drop to 6.5 cents per kilowatt-hour. When the program started, electricity production costs were in the order of tens of dollars per kilowatt-hour and it was uncertain whether photovoltaic systems, either as huge central stations or small roof mounted installations could successfully operate in harmony with electric grid. Ten years later it has been demonstrated that there are no technical drawbacks to the operation of small or large photovoltaic generators interconnected to the grid.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 8088, 8103, 8276

8064 **(SAND—86-8010) Testing of the Molten Salt Electric Experiment solar central receiver in an external configuration.** Bergan N.E. (Sandia National Labs., Livermore, CA (USA)). Oct 1986. Contract AC04-76DR00789. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002745.

The cavity surrounding the Molten Salt Electric Experiment (MSEE) solar central receiver was removed and the receiver was tested in an external configuration to compare external and cavity performance. The thermal efficiency of the external receiver was slightly less than that of the cavity receiver. However, operationally, the external receiver was easier to start up. Convective losses were measured from the external receiver and compared to analytical correlations. Measured convective losses were found to be 10% to 100% lower than predictions, most likely due to correction factors used in the predictions to account for surface roughness and wind direction. Four demonstration tests were performed on the external receiver. A high flux test exposed the receiver to flux levels of 1MW/m^2. The receiver was successfully filled in a serpentine rather than the customary flood pattern; and in another test the receiver was filled at temperatures below the freezing point of salt (470°F). In the final demonstration test, hot salt was used to keep the receiver warm overnight to allow sunrise start up. Receiver thermal losses overnight exceeded energy saved by reduced parasitics and energy collected from the sunrise start up, making overnight conditioning uneconomical for this receiver.

8065 **(SAND—86-8019) An assessment of solar central receiver systems for fuels and chemicals applications.** Radosevich, L.G.; Pretzel, C.W.; Carrell, E.H.; Tyner, C.E. (Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DR00789. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002744.

This report assesses the results of studies conducted to date for solar central receiver fuels and chemicals applications. Conceptual system designs using central receivers have been completed for ammonia/nitric acid, ammonia, and activated carbon production. Limited design and experimental information has also been developed for hydrogen production. A technical assessment of these applications revealed several technically deficient areas including molten carbonate salt materials research and technology development; reactor/receiver development; and thermochemical hydrogen process optimization, system design, and technology development. An economic assessment of the applications showed that none were currently attractive although the data for hydrogen production are too incomplete to draw meaningful conclusions. To further explore the potential of solar central receivers for fuels and chemicals applications, additional work on thermochemical hydrogen development is recommended along with the development of reactor/receiver concepts that have the potential for simplicity and increasing process efficiency.

8066 **Energy and availability transport losses in a point-focus solar concentration field.** Stine, W.B.; Heckes, A.A. (Mechanical Engineering Dept., California State Polytechnic Univ., Pomona, CA 91768). pp 955-960 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper presents the results of an experimental study of the losses in transporting thermal energy from a field of 114 point-focus solar collectors to a central thermal energy conversion system at the Solar Total Energy Project (STEP), Shenandoah, Georgia. Conduction and convection heat losses from the collector field piping and solar collector receivers and radiant energy losses from the solar collector receivers were measured. At normal operating conditions the steady state heat losses per unit of collector aperture area are 130 W/m/sup 2/ (41 Btu/hr-ft/sup 2/). The thermal mass of the collector field was found to be 3.92 kWh/°C (7,440 Btu/°F), which implies that 17% of the energy collected on a typical day is used to warm the field piping to its operating temperature. The loss of availability from the collectors and the field piping shows that only 21% of the solar energy falling on the collector field is delivered to the power cycle for conversion into electricity.

8067 **An assessment of central receiver systems.** Falcone, P.K.; Kistler, B.L.; Dawson, D.B.; Hruby, J.M.; Stoddard, M.C. (Sandia National Labs., Livermore, CA 94550). pp 1169-1173 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC04-76DP00789.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Technology options for solar central receivers have been examined in the context of recent analytical and experimental project results. Analytical studies were performed to examine the cost and performance of utility-scale central receiver systems for Rankine-cycle (steam turbine) electricity generation. Variables included in this work were the heliostat size and type, heliostat aiming strategy, field configuration, tower height, and receiver design a working fluid. Experimental results were used in both a qualitative and quantitative sense to aid in the design process.

8068 **Review of the characterization of molten nitrate salt for solar central receiver applications.** Carling, R.W.; Bradshaw, R.W. (Sandia National Labs., Livermore, CA 94550). pp 834-838 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Over the past several years Sandia National Laboratories, Livermore (SNLL), has had the responsibility from the U.S. Department of Energy to develop thermal energy transfer and storage technologies using advanced single-phase working fluids for solar central receiver (SCR) applications. Particular interest has focused on a mixture of sodium and potassium nitrate (NaNO/sub 3// KNO/sub 3/) because of the low melting point (eutectic at 222°C), availability of large quantities at low cost, and minimal hazards associated with its use. A comprehensive research program was established by Sandia to address issues relevant to the use of molten nitrates at high temperature (600°C). This report summarizes that work with the overriding conclusion that the use of molten nitrate

salt is technically feasible and a very attractive candidate for advanced SCR systems.

8069 **Closed loop thermochemical energy transport based on CO/sub 2/ reforming of methane: Balancing the reaction systems.** Fish, J.D.; Hawn, D.C. (Process Research Div. 6254, Sandia National Labs., Albuquerque, NM 87185). pp 935-940 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC04-76DP00789.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The objective of the Closed Loop Efficiency Analysis (CLEA) Project at Sandia National Laboratories is to develop the data base, the calculational tools, and the operational experience necessary for the design of cost-effective energy transport systems based on reversible chemical reactions. The primary application of interest is the transport of solar energy either from the collectors of a distributed system to a central site or from a solar energy plant of any type located in an ara of high solar insolation to a population or industrial center a few to several hundered kilometers away. A series of experiments and analyses have been carried out to explore the effects of catalyst selection, starting composition, reactor temperatures, system pressure, and water recycle on the operation and the efficiency of an energy transport system based on the reversible carbon dioxide reforming of methane. Both the experiments in the CLEA laboratory facility and the analyses indicate that the carbon dioxide/methane thermocheical energy transport system can be operted in a stable, closed-loop mode and that the system can be started up and shut down, as it must be daily in a solar application, without triggering either catastrophic instabilities or carbon deposition. Based on the success of the CLEA project, two new hardware projects have been initiated to address scale-up and direct solar interfacing.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 8046, 8096, 8102

8070 (CONF-860641—, pp 108-114) **DOMUS - ONE. A passive solar concept goes commercial.** Berndt, G.W.P. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

This paper describes the development of a German passive solar house, the "DOMUS-Solarhaus". Today it is the most wellknown passive solar concept for single family homes in Germany. Five years experience, thermal performance and operating data of a prototype, known as the "SEMM'S RESIDENCE" in Kiel, enabled the development of the "DOMUS" with design criteria especially for the climate of Mid-Europe. The most important design criteria are discussed. The author explains the way into the market. He has recently been awarded a grant from the Commission of the European Communities to build four demonstrations homes. The houses are located in Freiburg, Bielefeld, Kiel and Esbjerg. The project is realized in cooperation between the DOMUS Solarhaus GMBH and the Danish construction company E. Johannsen, Esbjerg.

8071 (CONF-860641—, pp 115-120) **Multifamily solar house in Gothenburg, Sweden.** Nordstroem, C.; Nordstroem, K. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A major part of the existing housing stock in Sweden, consists of multifamily houses built during the period 1950-1980. In the coming years these houses will undergo a large scale reconstruction, implying among other things a new insulated facade. This process has already started and is accelerating. The future energy consumption, concerning domestic heating, depends to a large extent on how the renovation of these buildings are executed. This paper describes a method how to install an air-based hybrid solar system in connection with the reconstruction - to convert the building into a solar house. By double exploiting, as far as possible, methods and labour for the reconstruction and the solar system, the additioinal costs of the solar system can be kept on a low level. A full scale project according to these ideas, is now under construction in Gothen burg, Sweden.

8072 (CONF-860641—, pp 121-126) **Utilization of solar energy for air-conditioning purposes in Iraq.** Andreasen, S.E.; Hummelshoej, R.M.; Harboe, S. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A large solar powered air-conditioning project in the centre of Baghdad, Iraq has recently been completed. Solar energy is used for space heating and to produce chilled water for cooling in a residential area named Abi Nawas Development, containing 293 luxury apartments with a total floor area of approximately 60,000 m^2. A total area of approximately 10,000 m^2 with high-efficiency flat plate solar collectors, and absorption chiller plants based on the water-lithium bromide cycle has been used. The performance results have been compared with the computer calculated performance and there has been found a good correlationship. The pay-back period for the described system has been calculated to 8-10 years, depending on the achievable solar contribution ratio.

8073 (CONF-860641—, pp 127-135) **Biggest solar water heating system in India - an evaluation.** Swarup, A.; Madan, S.; Sharma, J. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

In the past decades industries have been wasteful of energy during the period of cheap energy for good economic reasons. Now with high cost energy and depleting fossil fuels many changes are being introduced and it is now well established that with the commercial use of solar energy considerable reductions are possible without any effect on economic growth. Among the various application of solar energy, heating of water is one of the main commercial application which is economically viable in a tropical, developing country like India. Though there are many solar water heating systems put to commercial use in India, the biggest solar water heating system was commissioned on 24th September 1984, at Bhopal Dairy, Bhopal with the total heating capacity of 54,000 litres of water per day at an average temperature of 70 Deg C and covering an absorber area of 1082 Sq.metre. Now the solar water heating system is operating since more than an year, an effort has been made in this paper to evaluate the performance and the commercial applicability of the system. Also various problems and ways to eliminate these problems in the efficient working of bigger solar water heating systems with reference to Bhopal Dairy has also been discussed.

8074 (CONF-860641—, pp 167-173) **Development of standard test procedures for the determination of the long term thermal performance of solar domestic hot water systems.** Gilliaert, D.; Tebaldi, P. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

The paper gives an overview of the activity on SDHW system testing, carried out in the european collector and system testing group (CSTG), which is a concerted action managed by the Joint Research Centre. The ultimate goal of a testing procedure for the thermal characterization of a Solar Domestic Hot Water System is to give an estimation of the energy savings in normal users conditions at a given location. The paper gives the criteria and objectives for a test method, as decided in the CSTG, and describes the different approaches, with a discussion of the problems which are investigated, such as, load, auxiliary heater, controller,... The paper also gives a description of a common test procedure which will be further investigated and validated.

8075 (CONF-860641—, pp 174-179) **Experience with building integrated solar water heaters in Denmark.** Vejsig Pedersen, P. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

An example of an attractive building integrated solar system is the new compact thermosyphon solar water heater installed in 40 out of 55 solar low energy houses in Snekkersten north of Copenhagen. The compact solar water heater has a 3.5 m^2 solar collector and a 150 litres DHW tank in stainless steel, only 16 cm in thickness, placed behind it and combined into one compact unit. An electric heater positioned at the top of the DHW tank is used for supplementary heating. Continuous monitoring of four systems since the summer of 1985 shows very effective operation and a high system efficiency of more than 40% as was expected. The yearly saving amounts to 1975 kWh with a solar fraction of 65% when 200 litres of water per day are heated from 15 deg C to 45 deg C. During 1986 a modified system will be installed in 13 new houses in Veksoe situated west of Copenhagen.

8076 (CONF-860641—, pp 180-185) **Solar heating system for domestic hot water supply for a one family house.** Furbo, S.; Mikkelsen, S.E. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A simple and therefore relatively inexpensive small solar heating system for domestic hot water supply was installed by the Danish solar energy company BATEC in a one-family house in Koege. The cost of this solar heating system is about 30% less than the cost of the normal solar heating system marketed by the company. The thermal performance of the system has been measured in the period December 1985 - May 1986. The thermal performance of the system is as high as the performance of the normal system so that the profitability of the system is about 30% better than that of the normal systems marketed by the company.

8077 (CONF-860641—, pp 192-199) **Passive solar component testing using identification techniques.** Hammarsten, S.; Hattem, D. van; Bloem, H.; Colombo, R. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Since several years the Joint Research Centre of the Commission of the European Communities has an activity concerning Passive Solar Test Cells. The main objective of this activity is the development and assessment of test methodologies for passive solar components. In this paper a test method for passive solar components, using short term monitoring data from test cells, is presented. The method is based on the statistical identification of the parameters of a dynamic energy balance model of the test cell. The test structure is first calibrated with a highly insulated south wall, different south wall components are theninserted inplace of the calibration wall. The auxiliary heating is controlled by a Psudo Random Binary Sequence, which makes it possible to identify an energy balance model with short time measurements. Models with 4-(one capacitance) parameters and 7-(2 capacitance) parameters are found identifiable with measurement periods of 10-15 days. Shorter periods may be possible, if wheather conditions are stable during the measurement period. The estimated parameter values agree well with those calculated. However, further work is needed on the statistical aspects of the presented methods.

8078 (CONF-860641—, pp 200-205) **Investigation of solar walls by means of an indoor test facility.** Paludan-Mueller, C. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A test facility for measuring the characteristics of passive/hybrid solar walls has been constructed. The solar wall is installed in an insulated frame, and a "hot box" is placed on the inner side of the wall. The hot box provides well defined indoor conditions and the heat flow to or from the solar wall can be accurately determined. In case of measurements with collection of solar energy a solar simulator is used. In cases without solar radiation a "cold box" is placed in front of the solar wall. The results from the measurements show whether the wall works as intended, and they are used for the validation of models. By means of the validated model it is possible to calculate the annual performance of the actual solar wall.

8079 (CONF-860641—, pp 206-211) **Performance of passive solar walls in the Danish climate.** Olsen, L. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

The paper outlines and discusses the design and development of passive solar walls with special attention to non-vented mass walls. A testing programme of passive solar walls has been performed at an outdoor test facility at the Thermal Insulation Laboratory. The tests have been used for empirical validation of a computer simulation model. The model is applied for simulation of the thermal performance of different types of solar walls used in a standard house exposed to Danish climatic conditions. Systems which have a large thermal resistance between the storage of the solar wall and the ambient will be discussed. The expected annual savings will be reported for different configurations and different levels of solar and heat transmission.

8080 (CONF-860641—, pp 224-229) **Experimental solar house of the Luebeck Technical Institute. Results of four years of operation.** Weik, H.; Plagge, J. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Since summer 1982 a new solar heating concept has been tested in a one-family home with 130 m^2 heated area built on the site of Fachhochschule Luebeck, employing a dual-storage system (20 and 4 m^3) and an assisting 2 kW electric heat pump. The heating periods since proved the feasibility of the concept and also validated the expectations as to general and insolation economics. Particularly, due to the low temperature of the storage medium of the large tank during the heat extraction period, the 31 m^2 collector field efficiently collects even the low-intense winter solar radiation typical of the North-European climate. This permits to keep both the collector field and the volume of the heat reservoir tank within an economically reasonable size and limits the auxiliary energy demand to less than 6000 kWh per heating period for the thermal load of the house.

8081 (CONF-860641—, pp 230-234) **Output and experience with 31 solar domestic hot water systems in Denmark.** Mikkelsen, S.E. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

From the summer 1984 to the summer 1985 31 DHW systems were equipped with simple measuring equipment to control the utilized solar energy and the consumed energy. 9 of these were rather big systems with collector areas from 13 to 110 m^2. The output has currently been compared to the theoretically calculated performance and inspection of the systems and in some cases modifications have been carried out. In general, the small DHW systems functioned satisfactorily, and the users liked them. 13 out of 22 systems must have been overdimensioned, which meant that the measured output per m^2 has been low. The average measured consumption was 50 litres per person per day, but this varied much from one family to another. For 7 of the 22 systems the consumption was under 100 litres a day. A consumption like this requires a very simple system to make it profitable. The most severe defects were found in the solar collector circuit. It concerns bad distribution of the liquid, partly due to bad dimensioning, but most certainly because of air pockets.

8082 (CONF-860641—, pp 265-269) **SIMSYS - A simulation model for a solar heating plant.** Dalenbaeck, J.-O. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

SIMSYS is a simulation model for a heating plant with different energy production systems. The model can be used in the pre-design of a new heating plant or to study how different loads

effect the energy balance. The main purpose of the model is to model a solar heating plant with a seasonal water storage, with or without a heatpump between the storage and the load. The model can also be used to model a heating plant with an outdoor air heatpump or a conventional heating plant. The model is made executable on a DEC-computer and the program code is SIMULA. The main time step is one hour and measured data for outdoor air temperature and solar incident radiation for one year are required.

8083 (CONF-860641—, pp 270-275) **Different methods for defining and estimating the solar fraction for large solar heating systems.** Lund, P.D.; Peltola, S.S. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

This paper discusses the results of an intercomparison between different types of simulation models for seasonal storage solar heating systems and gives an estimate of the effects of system control and operational strategies on the overall system performance for a particular system, the Kerava solar village. The discrepancies between the different modelling approhaces are of the order of 15-50%. The most sophisticated models are able to simulate the system performance within 1-3% on an annual basis. The paper also discusses the various solar fraction definitions and presents suitable way to take into account for extra energy conservation means in the buildings.

8084 (CONF-860641—, pp 288-296) **Fuel savings of solar water heating systems.** Nielsen, J.E. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Based on simulation a simple method for calculating the fuel savings of solar water heating systems is developed. The method requires knowledge of load, collector tilt, fuel burner and the estimated yearly solar fraction. The results of the method are only valid for climates and latitudes comparable with the Danish, but methods for other climates and latitude could easily be made following the same principles. The method is used to show the influence of load, collector tilt, fuel burner and yearly solar fraction on the fuel savings of a solar water heating system. Some main results are: - Optimum collector tilt is 30 - 45deg. - The influence of the load is small for well designed systems. - The value of the "stand-by-losses" of the burner is of great importance. - If the "stand-by-losses" are large, the solar heating system should be dimensioned to give a high solar fraction.

8085 (CONF-860641—, pp 297-302) **Evaluation of thermal analysis models for buildings - within task 8 of the IEA solar programme.** Moerck, O.C. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Within Task VIII, "Passive and Hybrid Solar Low Energy Buildings" of the IEA Solar Heating and Cooling R and D Programme, one of the subtasks has focused on Thermal Simulation Programs for Buildings. A survey covering 31 programs in the member countries was conducted, followed by a validation programme for a selected number of these, the paper describes the results of these activities.

8086 (DOE/SF/15599—T1) **Central solar heating plants with seasonal storage: Evaluation of concepts.** Bankston, C.A. (CBY Associates, Inc., Washington, DC (USA)). Nov 1986. Contract AC03-85SF15599. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002834.

In colder climates, solar energy for heating of buildings is least abundant when it is needed most - during the winter. Therefore, seasonal storage is needed to make solar heat gained during warmer months available for later use. From investigations of various storage methods, two observations can be made: (1) The choice of storage method will greatly influence the working conditions for, and the optimal choice of the solar collectors and the heat distribution system; and (2) based on the technology that is available today, the most economic solutions will be found in large applications.

8087 **Daylighting data compendium.** Robbins, C.L.; Hunter, K.C. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). *Passive Solar Journal;* 3: No. 2, 191-206(1986).

A radiation data base for use in analyzing the performance characteristics of passive solar thermal systems has existed for many years. Such a data base for designing and analyzing daylighting systems has not previously existed on a city-by-city basis. This paper describes the end result of a multiyear research effort at SERI to develop a mathematical model to describe the daylight resource in various cities and to publish the resulting data in a format useful to architects, engineers, and lighting designers.

8088 **Thermochemical energy transport for a large heat utility.** Nix, R.G.; Bergeron, P.W. (Solar Energy Research Institute). pp 924-929 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper describes a feasibility study on using reversible chemical reactions to transport high-temperature thermal energy from a solar thermal heat source to a distant user. The user were 10 equally sized plants clustered in an industrial park with each user located an average of 0.8 km (0.5 mi) from the center. Each user required 26.2 MW/sub t/ (89.5 MBtu/h) of 4.14-MPa (600-psig)/ 400°C (750°F) superheated steam. The base case for comparison is a central fossil-fuel-fired boiler that transmits steam to the users. This study also considered transmitting high-temperature energy using molten salt as an alternative to thermochemical transport, as well as the effect of long-duration storage on delivered energy costs for some of the solar thermal cases.

8089 **Energy conversion processes supporting advanced thermal energy storage technologies.** Otto, R.J.; Berdahl, P.; Hunt, A.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 967-971 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC03-76SF00098.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Research that focuses on fundamental aspects of energy conversion could lead to innovative and improved energy storage technologies. Research progress in two energy conversion processes is summarized and the associated storage technologies described. These two processes are particle catalyzed solar photodissocation for thermochemcial energy conversion and storage, and the controlled emission of thermal radiation using narrow-bandgap semiconductor materials. The thermochemical energy conversion research at LBL is focused on the study of the endothermic dissociation of SO/sub 3/ by direct irradiation by concentrated sunlight. The reaction products, SO/sub 2/ and O/sub 2/, are recombined to produce high temperatures for driving thermal processes. The specific reaction mechanism involves the use of submicrometer metal oxide particles as solar absorbers and as sites for the decomposition of SO/sub 3/. The enthalpy of dissociation, 1.1 eV/molecule, is well within the energy available from the majority of solar photons. Several photocatalytic mechanism are being considered for direct coupling of the photon energy into the dissociation process. The research program is designed to ex;ore evidence of these mechanisms. Research on narrow-bandgap semiconductor materials is being pursued for the development of a solid state radiative heat pump. This work takes a fundamental approach to developing a solid state technology having the potential for exceeding the COP of a vapor compression heat pump while providing, at the same time, unique capabilities for energy storage system.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 8066, 8081

8090 **(BMFT-FB-T—86-071) Series production of solar absorbers/panel heat exchangers for utilization of solar radiation and ambient heat. Final report.** Gaertner, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Sep 1986. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87750295.

Development of a solar absorber under technological aspects of production, assembly and application including passive components of same superficial structure and colour. Development of a solar absorber, at the same time to be used as room closing, heat and sound insulating as well as fire resisting unit for outer wall or ceiling respectively roof for light-gauge steel construction, as well as with integrated heat insulation to provide for additional heat insulation in older buildings, where the existing insulation often is not sufficient to use the ambient warmth. Design of a pilot plant for the manufacture of absorber panels as integrated stand-mounted units, suitable for a compact absorber. Construction and use of part of the pilot plant projected for welding processing. Measurements of efficiency with special consideration of operational and climatic parameters. Development of a cellar-mounting heat accumulator consisting of heat-insulating sandwich elements in container design. Extensive know-how comprising climatic and operational aspects as well as efficiency and assembly techniques. With 52 refs., 12 tabs., 94 figs.

8091 (CONF-860641—, pp 65-70) **Solar collectors in a collective renewable energy system.** Lawaetz, H.; Lange, M. (Technological Institute, Copenhagen, Denmark). 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A district heating system based on renewable energy sources is established in a small town consisting of 100 houses. The heat is produced by collectors, a heat pump with energy absorbers and embedded coils, a straw burner, and an oil burner. Furthermore, two small windmills have been erected to produce electricity for the operation of the heat pump through the public grid. The operation is very untraditional as the temperatures of the district heating system are periodically very low, and consequently quite special house installations have to be designed. The solar collector area is 300 m^2 and placed on stands at the ground in front of the district heating station, facing south. The annual output from the solar system has been calculated to be 290 kWh per year in the Danish test reference year (TRY) and with an inlet temperature at 60 deg C.

8092 (CONF-860641—, pp 136-145) **Accelerated testing of absorbers for flat plate solar collectors.** Wennerholm, H. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

This study was performed to aid in the development of accelerated test methods needed for evaluation of absorber materials. Absorber materials included in the test program were black chrome, anodized aluminium, blue stainless steel, alkyd, akrylat, polyester, silicone and porcelain enamel. Substrates included steel, stainless steel, copper and aluminium. A single test specimen was used at each measurement point in the laboratory tests and in the outdoor exposures. In addition a number of complete collectors were exposed outdoors under stagnation. Absorptance and emissivity were measured before and after each test. Key degradation factors were identified as moisture, elevated temperature and sulphur dioxide.

8093 (CONF-860641—, pp 146-154) **Design of solar collectors.** Ravn, O. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

A graphical method to design solar collectors is described. Using the method one gets the connection between the solar collector design and the overall performance of the solar heating system in which the collector is applied. Two computer programs have been used to develop the method: 1. A program for calculation of solar collector efficiency from a detailed specification of the collector design. 2. A simulation program for calculation of solar heating system performance. The programs are described shortly. The graphical method is described together with one example of how to use it.

8094 (CONF-860641—, pp 155-160) **Analysis of a possibly perfect nonimaging concentrator.** Broman, L.; Roennelid, M.; Nordlander, S. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

We have done calculations and computer simulations (ray tracing) on two special nonimaging concentrators: A symmetric trough collector with absorber bottom, flat reflecting sides, and the top covered with a linear lens. An internally reflecting truncated cone, whose larger opening is covered with a lens. Our results indicate that the geometrics investigated may be close approximations to the theoretic limits for 2D and 3D geometries, respectively.

8095 (CONF-860641—, pp 161-166) **Climatic limitations and collector performance in the middle of Sweden.** Brunstroem, C.; Karlsson, B.; Larsson, M. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Climate and collector performances during 1985 are analyzed. The operating time of a stationary 45 deg C-tilted south directed collectors was limited to hours between 0600 and 1800 and irradiances exceeding 300 W/m^2. This means that these collectors annually received 794 kWh/m^2 of usable solar radiation during 1273 hours at an average ambient temperature of 14 deg C. The corresponding data for a 45 deg C-tilted E-W tracking concentrating collector are 739 kWh/m^2 of direct radiation at 1207 hours and 14 deg C. 90% of the irradiation was received during out-door temperatures between 0 deg C and 23 deg C. Around 60% of the heat produced by the collector was delivered between May and August with a maximum daily irradiation of 8.3 kWh/m^2 on the stationary and 10.8 kWh/m^2 of direct irradiation on the tracking surface. The integrated annual data showed that a well insulated flat plate collector produced 327 kWh/m^2, at 75 deg C, Philips vacuum tube collector produced 308 kWh/m^2 at 67 deg C and Liebi concentrating collector 361 kWh/m^2 at 70 deg C.

8096 (CONF-860641—, pp 186-191) **Energy wells recharged by solar heat.** Soederlund, M. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

If solar energy is to be able to compete with other energy sources in northern regions the collector system has to be inexpensive and simple. During the summer asphalt and roof surfaces are heated by the sun to relatively high temperatures. By spreading and collecting water which flows in a thin layer on such a surface a low temperature solar collector is created. Heat extraction from ground systems means a cooling of the ground. By recharging the energy wells with solar heat during the summer the temperature drop is kept within chosen limits.

8097 (CONF-860641—, pp 309-314) **Computer analysis of the circular solar cornet concentrator.** Nordlander, S.; Broman, L. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

The circular cornet is a useful solar concentrator for concentration factors up to about 20 and acceptance angles up to about 25 degrees. In this paper we give performance curves for a large number of cornets, covering the useful range of concentration factors and acceptance angles.

8098 **(LA-UR—86-1203) Efficiency of a solar collector with internal boiling.** Neeper, D.A. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 30p. (CONF-870101—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010174.

From American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting; New York, NY, USA (18 Jan 1987).

The behavior of a solar collector with a boiling fluid is analyzed to provide a simple algebraic model for future systems simulations, and to provide guidance for testing. The efficiency equation is developed in a form linear in the difference between inlet and saturation (boiling) temperatures, whereas the expression upon which ASHRAE Standard 109P is based utilizes the difference between inlet and ambient temperatures. The coefficient of the revised linear term is a weak function of collector parameters, weather, and subcooling of the working fluid. For a glazed flat-plate collector with metal absorber, the coefficient is effectively constant. Therefore, testing at multiple values of insolation and subcooling, as specified by ASHRAE 109P, should not be necessary for most collectors. The influences of collector properties and operating conditions on efficiency are examined.

8099 **(SAND—86-1873) Characterization of spherical ceramic particles for solar thermal transfer media: A market survey.** Hellmann, J.R.; McConnell, V.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002749.

Several candidates from a broad class of ceramic materials were evaluated for possible application as a solid thermal transfer medium in a high temperature solid particle solar receiver. This report documents the suppliers of the materials, the materials' characteristics, and comments regarding the suitability of each of the materials for solid thermal transfer media.

8100 **(SERI/TR—253-2338) Structural design considerations for stretched-membrane heliostat reflector modules with stability and initial imperfection considerations.** Murphy, L.M.; Simms, D.; Sallis, D.V. (Solar Energy Research Inst., Golden, CO (USA); Dan-Ka Products, Inc., Englewood, CO (USA)). Oct 1986. Contract AC02-83CH10093. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001102.

This report extends the work of several previous reports that present the background leading to the development of stretched-membrane modules and analysis methods to study the structural response of the stretched-membrane module. Specifically, this report presents and discusses the design implications based on our analysis of single- or double-membrane concepts, and the amplification of initial imperfections and deflections caused by loading, which results from stability considerations. In this document, we present analysis results for both single- and double-membrane concepts corresponding to a range of design and loading conditions. Further, we show that stretched-membrane/frame combinations respond quite differently to external loads than can be inferred by studying the decoupled frame and membrane independently. Thus the coupled membrane/frame problem should be considered to assure an accurate description of its response. For idealized configurations and loadings, we discuss the relative merits of various design features for both of these designs. In addition, we studied the structural stability (i.e., the tendency of structural deformation to grow with little increase in applied load) of the tensioned-membrane, compressed-frame combination. Moreover, we demonstrate how stability considerations are important in determining the amplification of both initial displacement imperfection and the deformations caused by wind and weight loading on the structure.

8101 **Receiver/reactor concepts for thermochemical transport of solar energy.** Diver, R.B. (Sandia National Labs., Albuquerque, NM). pp 961-966 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC04-76DP00789.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Thermochemical transport of solar energy based on reversible chemical reactions may be a way to take advantage of the high-temperature capabilities of parabolic dishes, while minimizing pipe network heat loss, since energy is transported at ambient temperatures in chemical form. Receiver/Reactor design is a key to making thermochemical transport a reality. In this paper the important parameters for solar receiver and chemical reactor design and how they relate to each other are presented. Three basic receiver/reactor types, applicable to thermochemical receiver design, are identified: (1) Tube Receiver/Reactors have tubular reactor elements which are directly heated by solar energy in the receiver; (2) Indirect Receiver/Reactors use an intermediate heat transfer fluid between the receiver and reactor; and (3) Direct Absorption Receiver/Reactors absorb sunlight directly on the reactor catalyst. Advantages, limitations, and risks associated with each design are discussed and examples of those that have been built are given. Each type offers its own set of advantages and risks, and warrant further investigation.

8102 **Performance/economics comparison of sensible and thermochemical energy transport systems for solar thermal dish applications.** Muir, J.F. (Sandia National Labs., Albuquerque, NM 87185). pp 941-948 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC04-76DP00789.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A major challenge facing the development of distributed receiver solar systems is the efficient transport of high temperature thermal energy from the collectors to the point of use. As receiver temperatures increase, conventional sensible (SEN) energy transport methods become less attractive because of increased heat losses nd insulation costs. A promising alternative that is particularly attractive for the high temperatures characteristic of paraboloidal dishes and the extensive piping associated with large collector fields is the concept of thermochemical (TC) energy transport. Estimates of the performance and economics of 4 SEN and 2 TC transport systems for a dish collector field are compared at 4 delivery temperatures ranging from 400 to 815°C. On the basis of levelized energy cost (LEC), there is no clear choice between SEN and TC energy transort at 400°C. At higher output temperatures, TC transport is more cost-effective and is the only viable choice at temperatures above $\approx$700°C. The TC system based on the carbon dioxide reforming of methane has the best performance and lowest costs at temperatures $>$400°C and appears closest to meeting the DOE Solar Thermal Technology (STT) Program long-term IPH goal.

8103 **An integrated heat pipe-thermal storage design for a solar receiver.** Keddy, E.; Sena, J.T.; Woloshun, K.; Merrigan, M.A.; Heidenreich, G. (Los Alamos National Lab., Los Alamos, NM 87545). pp 798-804 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Light-weight heat pipe wall elements that incorporate a thermal storage subassembly within the vapor space are being developed as part of the Organic Rankine Cycle Solar Dynamic Power System (ORC-SDPS) receiver for the space station application. The operating temperature of the heat pipe elements is in the 770 to 810 K range with a design power throughput of 4.8 kW per pipe. The total heat pipe length is 1.9 M. The Rankine cycle boiler heat transfer surfaces are positioned within the heat pipe vapor space, providing a relatively constant temperature input to the vaporizer. The heat pipe design employs axial arteries and distribution wicked thermal storage units with potassium as the working fluid. Stainless steel is used as the containment tube and screen material. Performance predictions for this configuration have been conducted and the design characterized as a function of artery geometry, distribution wick thickness, porosity, pore size, and permeability. Details of the analysis and of fabrication and assembly procedures are presented.

1420 Heat Storage

REFER ALSO TO CITATION(S) 8068, 8069, 8082, 8083, 8088, 8089, 8102, 8103

15 GEOTHERMAL ENERGY

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 8659

8104 **(CONF-860788—1) U/Th geochronology of hydrothermal activity in Long Valley caldera: Little Hot Creek and the Blue Chert.** Sturchio, N.C.; Binz, C.M.; Sorey, M.L. (Argonne National Lab., IL (USA); Loras Coll., Dubuque, IA (USA). Dept. of Chemistry; Geological Survey, Menlo Park, CA (USA)). 1986. Contract W-31-109-ENG-38. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001539.

From 2. workshop on hydrologic and geochemical monitoring of Long Valley caldera; Mammoth Lakes, CA, USA (15 Jul 1986).

To better define the evolution of the Long Valley hydrothermal system, we have embarked on a program of U/Th age determinations of hydrothermal products from outcrops and drill cores within the caldera. The U/Th system is appropriate for determining ages less than about 350 Ka in suitable materials. Results presented are from dense chalcedonic silica veins, collected from base to top of the outcrop beginning 40 m N of hot spring LHC-1 in Little Hot Creek canyon, and from samples of the Blue Chert.

1503 Geothermal Exploration And Exploration Technology

8105 **(DOE/NBM—7002454) Salton Sea Scientific Drilling Program: Seventh quarterly progress report, April-June 1986.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Geothermal Technology Div.). Sep 1986. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002454.

The progress and direction of the Salton Sea Scientific Drilling Program (SSSDP) is outlined. This reporting period, from April 1 through June 30, 1986, began with initiation of the 6-month shut-in period. Emphasis was placed upon conducting experiments such as downhole temperature and pressure surveys, distribution of samples to researchers, reporting and disseminating data thus far analyzed, and planning future operations in the SSSDP well.

1505 Economic And Financial Aspects

8106 **(DOE/AL/33162—T1) Handbook to guide the measurement and monitoring of project effectiveness and impact.** (SES Development Corp., Arlington, VA (USA)). 15 Sep 1986. Contract AC32-86AL33162. 207p. (In English and Spanish). NTIS, PC A10/MF A01. File Number DE87001991.

This handbook demonstrates the application of a tool for measuring and monitoring the impact of a development project in the Department of Quezaltenango, Guatemala. That project itself presently is a demonstration. It explores the technical feasibility and the commercial possibilities of direct geothermal heat applications to the processing of agricultural produce - with the eventual purpose of expanding agricultural exports from Guatemala. The handbook focuses on an early stage of the geothermal initiative and guides preparations for future impact measurement and monitoring of geothermal projects. Primarily, guidance is for projects in agricultural applications of geothermal heat - and basically in Quezaltenango. But the exercise and the handbook are relevant in broad outline to other, industrial applications projects as well which may be based in other departments and have immediate impact across the whole country. This handbook attempts to prepare geothermal energy planners in Guatemala for that juncture when geothermal projects can be managed by objectives. It promotes and facilitates thinking about defining specific objectives for projects that result from the demonstration at Zunil (in Quezaltenango Department); and it prompts preparations for obtaining baseline measurements and for making rational projections on the achievements of future projects.

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

8107 **(ETSU-WV—1570-P20) Lancaster Flexible Bag. Volume 3B - Technical appraisal. Consultants' 1983 report.** (Energy Technology Support Unit, Harwell (UK); Kennedy and Donkin, Consulting Engineers, Woking, Surrey (UK); Department of Energy, London (UK). Wave Energy Steering Committee; Rendel Palmer and Tritton, London (UK)). 1986. vp. British Library, Boston Spa, Wetherby, West Yorks.

A report is given by a team of Consultants on the estimated cost of converting wave energy to electrical energy by a 2 GW array of Lancaster Flexible Bag Devices and transmitting this to a sub-station on the west coast of Skye. Comparisons with the estimates made by the team developing the concept are made and discussed when not in agreement. A detailed engineering assessment is presented.

8108 **(ETSU-WV—1570-P22) Vickers Terminator. Volume 3C(VT) - Technical appraisal. Consultants' 1983 report.** (Energy Technology Support Unit, Harwell (UK); Kennedy and Donkin, Consulting Engineers, Woking, Surrey (UK); Department of Energy, London (UK). Wave Energy Steering Committee; Rendel Palmer and Tritton, London (UK)). 1986. vp. British Library, Boston Spa, Wetherby, West Yorks.

A report is given by a team of consultants on the estimated cost of converting wave energy to electrical energy by a 2 GW array of Vickers Terminator wave energy devices and delivering the electricity to a sub-station on the west coast of Skye. Comparisons with the estimates made by the team developing the concept are presented and are largely in agreement, except for the capital cost per device and the power chain efficiency. A detailed engineering assessment is given.

8109 **(ETSU-WV—1570-P23) Vickers Attenuator. Volume 3C(VA) - Technical appraisal. Consultants' 1983 report.** (Energy Technology Support Unit, Harwell (UK); Kennedy and Donkin, Consulting Engineers, Woking, Surrey (UK); Department of Energy, London (UK). Wave Energy Steering Committee; Rendel Palmer and Tritton, London (UK)). 1986. vp. British Library, Boston Spa, Wetherby, West Yorks.

A report is given by a team of Consultants on the estimated cost of converting wave energy to electrical energy by a 2 GW array of Vickers Attenuator wave energy devices and delivering this to a sub-station on the west coast of Skye. Comparisons of the estimates made by the team developing the concept are presented and discrepancies discussed. A detailed engineering assessment is given.

8110 **(ETSU-WV—1570-P25) N.E.L. Floating Terminator. Volume 3C(NFT) - Technical appraisal. Consultants' 1983 report.** (Energy Technology Support Unit, Harwell (UK); Kennedy and Donkin, Consulting Engineers, Woking, Surrey (UK); Department of Energy, London (UK). Wave Energy Steering Committee; Rendel Palmer and Tritton, London (UK)). 1986. vp. British Library, Boston Spa, Wetherby, West Yorks.

A report is given by a team of Consultants on the estimated cost of converting wave energy into electrical energy by a 2 GW array of NEL Floating Terminator Devices and delivering the electricity to a sub-station on the west coast of Skye. A detailed engineering assessment is given. Comparisons with the estimates made by the team developing the concept are presented and discrepancies discussed. The main cost differences are caused by the different as-

sessments of the power conversion efficiency and the electrical transmission costs.

17 WIND ENERGY

1701 Availability (climatology)

8111 (ECN—85-168) Wind velocity measurements at ECN during 1984. Lekkerkerk, F.; Looijesteijn, C.J. (Netherlands Energy Research Foundation, Petten). Sep 1985. 33p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report describes wind velocity measurements during 1984 at the test-site for wind turbines on the grounds of the Netherlands Energy Research Foundation near Petten at the west coast of The Netherlands. 7 figs., 20 tabs.

1703 Regulations

REFER ALSO TO CITATION(S) 8125

8112 (ECN—86-151) Developments in the application of wind energy in The Netherlands. Stam, W.J. (Netherlands Energy Research Foundation, Petten). Aug 1986. 22p. (CONF-8606237—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From DANWEA '86 conference and exhibition; Herning, Denmark (11 Jun 1986).

Wind turbine developments in The Netherlands cover a wide range of technical concepts. The ECN test station for wind turbines plays an important role in these developments. The developments on use of wind energy in The Netherlands, including licensing, certification and standards, are described and information is given on wind turbine manufacturers and the types of wind turbines they produce. 3 figs.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 8111, 8112, 8112, 8146

8113 (ECN—85-181) NOW pilot project Camperduin. Interim report. Period October 1983-June 1985. Van Hulle, F.; Schuurman, J.; Curvers, A.; Boone, M.; Van de Scheer, B.; Westra, C.A.; Welsink, M. (Netherlands Energy Research Foundation, Petten; Amsterdam Univ. (Netherlands)). Nov 1985. 27p. (In Dutch). (ECN-UvA-PEN—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The authors describe the performance test results of the wind turbine pilot project at Camperduin at the west coast of The Netherlands, 40 km northwest of Amsterdam during the period October 1983-June 1985. This pilot project is part of the second national research and development program on wind power (NOW II). The two wind turbines are produced by Lagerweij-v.d. Loenhorst, both having a rotordiameter of 10.6 m. 5 figs., 3 tabs.

8114 (ECN—85-185) Application of wind turbine conversion systems with a DC intermediate stage. Looijesteijn, C.J. (Netherlands Energy Research Foundation, Petten). Dec 1985. 80p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

After a review of used conversion systems of wind turbines, attention is focussed on specific properties in general and a conversion system with a DC intermediate stage in particular. Next part of the report describes forms of not desired electric power grid interference by grid-coupled wind turbines, especially if a DC-AC converter is used. Examples are given. The final part of the report deals with power output calculations. A computer program, EPWT, has been developed for this purpose. Together with wind velocity measurements it generates the desired data. 26 figs., 19 refs., 4 tabs.

8115 (ECN—86-001) Wind turbines in the Peoples Republic of China. Report of a visit, September-October 1985. Dragt, J.B. (Netherlands Energy Research Foundation, Petten). Nov 1985. 49p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A delegation of wind energy experts of four European countries has been invited to pay a visit to China from September 16-October 6, 1985, in the framework of exchange of information on test sites for wind turbines. The potential of wind power in China and the state of affairs with respect to wind power are described. Information is given on visited test sites, visited research institutes and development activities. Possibilities for cooperation are outlined. Concluding remarks are formulated and some recommendations are given. 10 figs., 14 refs.

8116 (ECN—86-038) Structural vibration frequencies and drive train behaviour of 15 m VAWT. Machielse, L.A.; Rieffe, H.C.; Peeters, P.M. (Netherlands Energy Research Foundation, Petten). Mar 1986. 9p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The experimental vertical axis wind turbine (VAWT), Pionier I, was erected in Amsterdam in spring 1982. The cantilever turbine has 2 troposkien shaped GFRP blades. Rotor height and diameter are 15 m. A grid connected DC-AC system of 93.8 kW nominal power enables operation at variable and at constant rotor speed. Since the beginning of 1985 the Netherlands Energy Research Foundation (ECN) is carrying out a measurement programme on the turbine. This programme is part of the National Development Programme on Wind Energy (NOW-II) and is sponsored by the Project Office for Energy Research Management (PEO). The paper reports about the preliminary measurements on the turbine's dynamic behaviour. Vibrational frequencies of the turbine structure were measured and compared to earlier measurements and to calculations in the design phase. The influence of the turbine control during variable speed operation on drive train dynamic response is analysed. The response on the aerodynamic torque ripple is measured at constant speed operation. Torque ripple on the shaft is decreased to 5% of average torque. The measured vibration frequencies show good agreement with the calculations. The rotational speed of the turbine follows wind speed fluctuations up to .14 Hz in constant tip speed operation. 6 figs., 3 refs.

8117 (ECN—86-060) Use of a wind turbine for powering the waste water purification plant at Goedereede. Results of measurements, September 1984-January 1, 1986. Curvers, A.; Schuurman, J.J. (Netherlands Energy Research Foundation, Petten). Apr 1986. 38p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The wind turbine, with 16 m rotor diameter (55 kW), has beer operated since April 1983. Availability of the wind turbine from April 1983-January 1, 1986: 95.7%. Because of the continuous power demand (minimum: 40 kW) the power generated by the wind turbine could be used for 90%. Degree of self-supporting: 19.6%. A number of signals, measurements of 10 minute averages, are fed to an Apple-computer. Results of the measurements are presented. The authors conclude that use of a wind turbine on this location is economically feasible. 12 figs., 4 tabs., 2 refs.

8118 (ECN—86-068) ECN-wind turbine test station. Wind turbine rotor axis drive facility (RAAF). Ramakers, S.G.; De Bonte, J.A.; Kraaivanger, A.W.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1986. 17p. (In Dutch). (CONF-851274—10). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

At the ECN wind turbine test station at Petten a rotor axis drive facility has been installed to test commercial wind turbine nacelles at ground level before erecting the wind turbines at the test site. Conversion system tests, balancing rotary parts, adjustments of safety provisions, power, speed, etc. can be performed. Power range of the facility is 4-100 kW. The facility is described and application possibilities are given. 9 figs.

8119 **(ECN—86-069) ECN wind turbine test area. General practice.** Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1986. 25p. (In Dutch). (CONF-851274—5). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

The Netherlands Energy Research Foundation ECN has the facilities to test wind turbines, produced by the Dutch wind turbine industry. Tests have been executed for 4 years now. Mechanical, aerodynamic, electrical and environmental properties have been measured and analyzed for different types of wind turbines. The testing is part of the national research program on wind power and is financed by that program. The tests have been performed in accordance with the concept standard NEN-6096 which proved to be a manageable guideline. 4 figs., 4 tabs., 8 refs.

8120 **(ECN—86-070) Turbulence and wind turbine rotor loads.** Dragt, J.B. (Netherlands Energy Research Foundation, Petten). Feb 1986. 15p. (In Dutch). (CONF-851274—11). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

Globally described is a way to calculate the interaction between turbulent wind fields and wind turbine rotors and its influence on rotor design calculations. Calculations and actual measurements of the response of the rotor system of the 25 m rotor diameter horizontal axis wind turbine in Petten, The Netherlands, are compared with respect to the axial force on the rotor. An example of an application on a flexible rotor is shown. Finally some remarks are made on this method of modelling. 2 figs., 3 refs.

8121 **(ECN—86-071) The 25 m rotor diameter horizontal axis wind turbine (HAT) and the development of modern wind turbines in The Netherlands.** Dekker, J.W. (Netherlands Energy Research Foundation, Petten). Feb 1986. 11p. (In Dutch). (CONF-851274—6). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

The 25 m HAT is working for more than 4 years now. Design, construction and testing during that period have been financed by the Dutch national research program on wind power. The results of the measurements are used by the Dutch wind power industry to improve their products. Future testing will focus on flexible rotor blades fitted with movable tipvanes. 13 refs.

8122 **(ECN—86-072) Determination of power- and axial force coefficients of the 25 m HAT, ECN, Petten.** Dekker, J.W.; De Groot, C.M. (Netherlands Energy Research Foundation, Petten). Feb 1986. 33p. (In Dutch). (CONF-851274—3). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

Tests are performed at the 25 m horizontal axis wind turbine. The measurements made to determine power coefficients and axial load coefficients are described and compared with previous measurements and calculated values. 18 figs., 1 tab., 15 refs.

8123 **(ECN—86-073) Control systems for the 25 m rotor diameter wind turbine at Petten.** Lekkerkerk, F.; Van Engelen, T.G. (Netherlands Energy Research Foundation, Petten). Feb 1986. 24p. (In Dutch). (CONF-851274—7). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

Two methods are described for controlling the 25 m wind turbine at Petten (North-western part of The Netherlands): controlling the speed of revolutions of the rotor and controlling the armature current respectively. 10 figs., 5 refs.

8124 **(ECN—86-074) Simple 'bondgraaf'-model for simulation of the dynamic behavior of the driving unit of a wind turbine.** De Groot, C.M.; Dekker, J.W. (Netherlands Energy Research Foundation, Petten). Feb 1986. 42p. (In Dutch). (CONF-851274—4). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

User-friendly computer simulation models are necessary for developing and testing wind turbines. A special method of description is presented called 'bondgraaf'-method, used in the simulation model. The modelling of the driving unit of a wind turbine and the results of a number of simulation runs are presented. 24 figs., 7 tabs., 4 refs.

8125 **(ECN—86-075) Review of standards/codes of practice related to safety and reliability of wind energy conversion systems.** Beurskens, H.J. (Netherlands Energy Research Foundation, Petten). Feb 1986. 22p. (In Dutch). (CONF-851274—8). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

An overview is given of standards which are developed or have been developed with respect to safety and reliability of wind energy conversion systems. The countries involved are: Canada, Denmark, Federal Republic of Germany, The Netherlands, Sweden and the United States of America. 8 figs., 4 tabs., 19 refs.

8126 **(ECN—86-076) VAT-15 performance testing.** Machielse, L.A. (Netherlands Energy Research Foundation, Petten). Feb 1986. 20p. (In Dutch). (CONF-851274—12). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

In September 1982 the Netherlands Energy Research Foundation (ECN) started performance testing of the 15 m rotor diameter vertical axis wind turbine, erected in Amsterdam (Gaasperplas). The two troposkien shaped blades have a polyurethane core covered with a skin of glass fibre reinforced polyester. Measured are: rotor signals, tower signals, electrical signals, linear speed signals and signals of atmospheric conditions. Average start and stop wind velocities are 5 and 3.2 m/s respectively. Starting up the turbine only demands 0.03 kWh. Automatic operating at 20 m/s wind velocity generates 65 kW alternating current output. Some results are presented. Testing is done within the framework of the National Program Plan on Wind Power (NOW-II) 10 figs., 3 refs.

8127 **(ECN—86-077) Axial force as design load for wind turbines.** Van der Borg, N.J.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1986. 21p. (In Dutch). (CONF-851274—9). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

One of the variables which are measured as part of the standard test on the wind turbine test site of the Netherlands Energy Research Foundation in Petten is the axial force. The axial force is considered to be one of the design criteria for wind turbines. Results of axial force measurements of nine wind turbines are presented. The developed procedure turns out to be very useful. 10 figs., 1 tab., 6 refs.

8128 **(ECN—86-078) Decentral applications of wind turbines: empirical facts from pilot projects.** Curvers, A.; Van Hulle, F.; Schuurman, J.J. (Netherlands Energy Research Foundation, Petten). Feb 1986. 23p. (In Dutch). (CONF-851274—13). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (17 Dec 1985).

Testing decentralized power generation by wind turbines requires pilot projects. The Netherlands Energy Research Foundation is involved in four projects with respect to testing: the projects Camperduin, Flappevaart, Oudkarspel and Goedereede, respectively. A brief description of the projects is given. Technically well

functioning wind turbines result in the final phase of the projects. Feasibility studies differ in outcome. A limiting factor in 1981 or 1982 has been the choice of the system because at that time only few systems were commercially available. 2 figs., 8 tabs., 8 refs.

8129 **(ECN—86-117) GAPHAT-1. Global analysis program for horizontal axis wind turbines (pc-version).** Roorda, B.; Bloemen, H.A.; IJpelaan, R.; Soullie, P.P. (Netherlands Energy Research Foundation, Petten). Sep 1986. 31p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

When designing wind turbines a number of design parameters appear to be dependent on the behavior of the turbine. To analyse that behavior in a simple and cheap way the computer program GAPHAT-1 has been developed. The program can be used for exploratory analyses of control behavior of wind turbines with variable number of revolutions and blade pitch angle. The program has been written in Basic for microcomputers with operating system MS-DOS (IBM compatible). It works interactively and is menu-driven.

8130 **(ECN—86-118) Introduction to the autonomous wind diesel system for Tarrafal (RCV).** De Bonte, J.A. (Netherlands Energy Research Foundation, Petten). Sep 1986. 18p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In all locations where electric power is generated by diesel generator units, fuel can be saved by application of wind turbines operated parallel with the diesel generator units. Problems arise when the wind power exceeds the power demand. The surplus of wind power can be transformed into heat or is used for cooling or pumping water. In the village of Tarrafal in the Republic of Cape Verde a 175 kW diesel plant supplies the required electric power during 6 hours a day, being the typical load power of the village. Beyond the load of Tarrafal three water pumps will be supplied by the autonomous wind diesel system too. Estimated fuel savings and investment costs are given. 9 figs.

8131 **(ECN—86-119) Report of activities on autonomous wind-diesel systems in 1985.** De Bonte, J.A.; Klerks, W.M.; Pierik, J.T. (Netherlands Energy Research Foundation, Petten). Aug 1986. 16p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In the framework of the Dutch National Program Plan on Wind Power (NOW-II) activities of the Netherlands Energy Research Foundation (ECN) on autonomous wind-diesel systems (AWDS) are described. Two designs are tested: ECN-design for a standard wind turbine with a synchronous generator (in the 12 kW test arrangement rotor and transmission are simulated by a DC-machine), and a design of the Technical University of Eindhoven for wind turbines with synchronous generator. A 50 kW test arrangement is used for two wind turbines with 10.6 m rotor diameter and variable speed. Details are given. To calculate the dynamic behavior of the systems computer programs have been written and tested. For the Cape Verdian Islands an AWDS has been designed. It will be tested on the test station in Petten. 2 figs., 16 refs.

8132 **(ECN—86-121) Characteristics and data on automatic operation and braking behavior of a 15 m rotor diameter Darrieus wind turbine.** Peeters, P. (Netherlands Energy Research Foundation, Petten). Jul 1986. 31p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Near Amsterdam (Gaasperplas) a 15 m rotor diameter Darrieus (vertical axis) wind turbine has been erected. The Netherlands Energy Research Foundation (ECN) is conducting dynamic behavior measurements since September 1982. Because of the recalibration of the tachometer and anemometer speed of revolutions-, power-, and stress-characteristics have been measured. The behavior during mechanical and electrical braking is compared. 16 figs., 1 tab., 5 refs.

8133 **(ECN—86-125) REGHAT 1; a computer program for transient stability analysis of horizontal axis wind turbines. Volume 1. Mathematical models.** Cervenka, S.; Pierik, J.T. (Netherlands Energy Research Foundation, Petten). Sep 1986. 91p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The mathematical models of the computer program REGHAT for transient stability analysis of horizontal axis wind turbines are described. Models of the wind, turbine rotor, drive train, electrical generators, electronic power converters, analog regulators and a servomechanism as well as a microprocessor-based controller are included. The current version is based on a program developed by T.G. van Engelen. The program has been updated and extended with new models, including models for a.c. generators into a modular structured simulation program. 22 figs., 1 tab., 13 refs.

8134 **(ECN—86-126) REGHAT 1; a computer program for transient stability analysis of horizontal axis wind turbines. Volume 2. User's manual.** Cervenka, S.; Pierik, J.T. (Netherlands Energy Research Foundation, Petten). Sep 1986. 145p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The computer program REGHAT for transient stability analysis of horizontal axis wind turbines is described. The items that are discussed include the program organization, a detailed description of the present model blocks along with a discussion on the assembly of a system model from these blocks. Some remarks on initialization and choice of integration method are made. A detailed description of the program input deck is provided. The program is demonstrated by means of two examples: the simulation of a response of the experimental HAT-25 wind turbine situated at the ECN test site, and the simulation of a response of a variable speed wind turbine of type Lagerwey. REGHAT is written in Advanced Continuous Simulation Language (ACSL). 31 figs., 4 tabs., 7 refs.

8135 **(ECN—86-128) NORMHAT. A computer program written in Basic for the calculation of the formulae of the NEN-standard 6096.** Neelen, M.J. (Netherlands Energy Research Foundation, Petten). Sep 1986. 27p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The program NORMHAT calculates momentum and forces working on a wind turbine by using formulae of the NEN-standard 6096. These variables are being calculated for different parts of the wind turbine. The program has been written in MSX DOS Basic for IBM or IBM compatible computers. An example is given. 3 figs.

8136 **(ECN—86-130) PHATAS-1; program for horizontal axis wind turbine analysis and simulation. Volume 2. Users's manual.** Jehee, J.N.; Snel, H. (Netherlands Energy Research Foundation, Petten). Sep 1986. 117p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The present volume is meant to aid the user of the PHATAS computer program (for horizontal axis wind turbine analysis and simulation) in preparing a sensible input and obtaining a likewise output from a PHATAS run. The program structure is briefly described to give the user some idea of the data flow. The input file needed for a successful run is shown in detail. The standard and optional output is also shown and the interaction with the post-processor PRESENT to obtain plotted or tabulated output is made clear. Complete examples are given for more clarity. The development of the PHATAS program was sponsored by PEO (formally BEOP) Management Office of Energy Research Projects. 1 fig., 2 refs.

8137 **(ECN—86-132) ECN wind turbine test station. Fluctuations in the electric power from wind turbines.** Stam, W.J.; Van der Borg, N.J. (Netherlands Energy Research Foundation, Petten). Sep 1986. 14p. (CONF-8610168—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 6. international meeting of test stations for wind turbines (IMTS 1986); Schnittlingen, F.R. Germany (2 Oct 1986).

Due to the stochastic nature of wind, the electric power generated by wind turbines is in general far from constant. The measurement of power fluctuations of wind turbines forms a part of the standard test program of the wind turbine test station of ECN. Here, the need is felt to define a quantity which is a measure of the power fluctuations. This quantity must reflect the properties of the tested turbine in such a way that the various turbines can be compared easily. A quantity is proposed (the power fluctuation coefficient, PFC) which seems suitable for this purpose. PFC's are presented for 8 tested wind turbines. 8 figs., 1 tab.

8138 **(ECN—86-138) Testing of the conversion system of a 10.6 m rotor diameter Lagerweij wind turbine on the rotor axis drive gear facility (RAAF).** De Bonte, J.A.; Kraayvanger, A.W. (Netherlands Energy Research Foundation, Petten). Mar 1986. 36p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A nacelle, having a 35 kVA synchronous generator with transmission, has been coupled via a DC intermediate stage to the power grid. Measurements conducted with the conversion system of the nacelle are described and characteristics of the system are presented. 24 figs., 6 tabs., 4 refs.

8139 **(ECN—86-149) Measurement programme for the 45 m horizontal axis wind turbine, Wieringermeer, The Netherlands.** Dekker, J.W.; De Groot, C.M. (Netherlands Energy Research Foundation, Petten). Sep 1986. 8p. (CONF-861062—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

The electric utility PEN has installed a 45 m rotor diameter horizontal axis wind turbine, NEWECS-45, at Wieringermeer, The Netherlands. The Netherlands Energy Research Foundation is carrying out a measurement programme that started in April 1985. The measurement programme, focussed on mechanical loads and turbine behavior, can be divided in two parts: short term measurements during the three start-up stages (300 kW, 650 kW and 1 mW), and long term measurements during one year of normal operation. The signals monitored are: wind signals from mast and nacelle, as well as temperature and pressure; signals from the control and safety system; strain-gauge signals, located at blade root, fast axis and tower; accelerometer signals from the nacelle; logical signals from the control system. 48 Signals are fed into a PDP 11/34 micro computer. First results on safety system checking and normal operation are presented. 10 figs., 1 tab., 2 refs.

8140 **(ECN—86-150) Axial thrust measurements on wind turbine rotors and comparison of measured data with guidelines.** Van der Borg, N.J.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Sep 1986. 7p. (CONF-861062—2). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

One of the most important mechanical loads on a wind turbine is the aerodynamical force on the running rotor in axial direction: the axial thrust. Its measurement forms a part of the standard test program of the wind turbine test station of the Netherlands Energy Research Foundation ECN. The results of the measurements can be used for a possible re-design of the specific turbine and for the development of guidelines to be used in the prediction of axial thrust on turbines in general. These guidelines are of interest for the design of wind turbines and for the development of safety standards. Axial thrust measurements have been performed on nine horizontal axis wind turbines with rotor diameters from 6 to 25 m, with fixed pitch and variable pitch, with constant rotational speed and with variable rotational speed. The measured axial thrust characteristics are compared with existing guidelines. The applied instrumentation, the experimental procedure and the data processing are described. 9 figs., 1 tab., 8 refs.

8141 **(ECN—86-153) Safety of small and medium scale wind turbines.** Beurskens, H.J.; Elliot, G.; Hjuler Jensen, P.; Molly, J.P.; Schott, T.; De Wilde, L. (Netherlands Energy Research Foundation, Petten). Oct 1986. 6p. (CONF-861062—3). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

In order to guarantee safe operation of a wind turbine for the operators and for the public, it is necessary that wind turbines are designed to comply with well defined specifications and incorporate adequate safety systems. These specifications should be based on a safety philosophy which is derived from accepted standards relating to machinery and from actual operational experience. With the aim of establishing a firm basis to be used to arrive at safety recommendations a CEC project has been carried out which can be subdivided into two main parts: the establishment of a method to systematically collect, process and redistribute information on accidents and incidents, and the development of methods to analyse the collected information in order to derive safety recommendations. A questionnaire has been developed for both electricity generating and water pumping wind turbines by means of which an accident or incident can be recorded. As the completed questionnaires (37) available by August 1986, were considered both to be too small a number and a selective choice among known accidents and incidents, it was considered incorrect to treat this data statistically and another analysing method was used. From the recorded events only those events were considered which were typically connected to wind turbine machinery. The analysis of this material led to a number of specific safety recommendations. As the cases which were considered representative of a larger number of actual incidents, then these recommendations are considered to be a first approach to a set of recommendations for general application, which would be completed in the near future. 3 figs., 1 tab., 1 ref.

8142 **(NP—7770023) Power electronics matching circuits for wind-driven generators with storage batteries.** Fuchs, A. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 21 May 1985. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770023.

Circuits for matching the 3 phase current of the generator to the DC voltage system of the storage battery for synchronous and asynchronous generators in wind-driven generators are examined analytically and experimentally. As simple circuits do not permit power matching to the generator, electronic matching circuits are described, which make possible the optimum matching of the power of the wind rotor to the generator by setting members and suitable regulators. A numerical simulation with frequencies of transition of the wind speed including the store and the load is also done. The long term operating behaviour of a converter with a simple matching circuit and that of a converter with a regulated circuit are compared.

8143 **(RISO-M—2481) Wind turbine test. Wind Matic WM 15S.** Pedersen, T.F. (Risoe National Lab., Roskilde (Denmark)). Jul 1986. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750338.

The report describes standard measurements performed on a Wind-Matic WM 15S, 55 kW wind turbine. The measurements carried out and reported here comprises the power output, system efficiency, energy production, transmission efficiency, rotor power, rotor efficiency, air-brakes efficiency, dynamical behaviour of the turbine, loads at cut-in and braking, rotor torque at stopped condition, and noise emission.

8144 **(RISO-M—2531) Risoe's design basis for small to medium size Danish windmills.** Lundsager, P.; Jensen, P.H. (Risoe National Lab., Roskilde (Denmark)). Sep 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750337.

The report presents a simple design basis for Danish windmills. The design basis has been developed in connection with the licensing of windmills at the Test Station. The background for the development of the design basis is outlined, and the design load cases are defined. The load cases are applicable on the condition that a number of functional requirements are fulfilled, and these requirements are specified. Finally, the impact of the design basis on the development of windmill failure rates and performance is outlined.

8145 **(STEV-VIND—86-5) Hoenoe wind power station, the control system.** Ulen, E. (Statens Energiverk, Stockholm (Sweden)). Apr 1986. 37p. (In Swedish). (FOA-C—20611-E3). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750361.

The report describes the design of the control system that will be included in the rebuilding of Chalmers Wind Power station at Hoenoe.

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REFER ALSO TO CITATION(S) 7907, 8128, 8130, 8130, 8313

8146 **(ECN—86-029) Estimation of the fuel savings by wind energy integration into small diesel power grids.** Oei, T.D. (Netherlands Energy Research Foundation, Petten). Mar 1986. 17p. (CONF-860320—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 8. British Wind Energy Association conference; Cambridge, UK (9 Mar 1986).

Fuel consumption studies were performed by a computer model for small diesel stations for various degrees of wind energy penetration. For given load duration curve of the station and power duration distribution of the wind plant, fuel consumption has been calculated with a diesel station of various power mix. Further it is assumed that at least one diesel unit remains connected to the bus to serve the load. Spinning reserve at various levels of the demand is defined in relation to the power mix of the station. Required connected capacity to the bus at various load levels of the station takes account of this spinning reserve and the power variation of the wind plant. By further consideration of the Willans equation for the diesel fuel consumption, properties of this equation show methods for improved fuel displacement. At low penetration of the wind energy, only an amount of fuel equal to the marginal fuel consumption of the unit on load frequency control is displaced. With increasing wind energy penetration, more than this amount may be gained by reducing the no-load fuel consumption, provided the power mix of the station is suitably chosen. To further increase the wind energy penetration, in particular for stations with higher peak to base load ratios, an amount of excess wind energy may be used to drive the diesel engines to overcome the no-load resistance of the engine. By externally supplying this power, the throttle action of the machine is directly influenced while power output is maintained. 8 figs., 5 tabs., 13 refs.

8147 **(EPRI-CS—4736) 1985 heat-rate improvement workshop. Proceedings.** Diaz-Tous, I.A.; Lansing, N.F. (eds.). (Encor-America, Inc., Los Altos, CA). Sep 1986. 512p. (CONF-8510376—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920072.

From Heat-rate improvement workshop; San Francisco, CA, USA (9 Oct 1985).

An EPRI-sponsored workshop to address heat rate improvement of existing fossil-fuel plants was held in San Francisco, California on October 9-11, 1985. Pacific Gas and Electric Company was the host for the meeting, which was attended by 240 representatives from 65 utilities, 36 manufacturers and consulting firms, and several public agencies. The workshop was held to provide a forum for participants to meet and discuss current issues and problems of heat rate improvement, and to exchange information on means to achieve increased efficiency. The meeting was organized around three principal themes: utility experience with heat rate improvement, including monitoring and overall programs; technology developments to assist heat rate improvement; and testing to make accurate evaluations of heat rate, both for monitoring performance and for evaluating the changes resulting from modified equipment and practices. In addition, there were working group discussions on: instrumentation and performance monitoring; heat rate improvement program; ASME performance test codes; and equipment efficiency improvements. Individual papers have been entered into EDB and ERA.

8148 **(EPRI-CS—4748) Second EPRI incipient-failure detection conference: proceedings.** McAnally, M. (ed.). (Radian Corp., Austin, TX (USA)). Oct 1986. 725p. (CONF-8410452—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920073.

From 2. EPRI incipient-failure detection conference; Lake Buena Vista, FL, USA (10 Oct 1984).

A workshop was held in Lake Buena Vista, Florida on October 10-12, 1984. The workshop presented new and updated techniques for incipient failure detection in power plants. These proceedings include the text of formal presentations on the Seminar Sessions, as well as summaries of the discussions from the Working Group Sessions. The workshop was well attended with a formal registration of 179 and with 18 companies showing a variety of products and services. The Seminar Sessions addressed the following topics: Vibration Monitoring Program; Vibration Signature Analysis; Turbine-Generator Monitoring; and Current Research and Developments. Thirty papers were presented, in addition to the Seminar Sessions, a period was set aside for the attendees to participate in a Working Group of their choice. There were four Working Groups that discussed the following: Current Utility Monitoring Practices; Vibration Monitoring and Analysis; Turbine-Generator Monitoring; and Boiler Monitoring Method. Individual papers have been entered into EDB and ERA.

8149 **(EPRI-EL—4658-SR) Workshop on generator reliability: proceedings.** Sharma, D.K. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1986. 226p. (CONF-8512101—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080.

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Generator reliability is an issue of prime importance to utilities. The objective of this EPRI Workshop was to bring utilities together to discuss the various issues affecting generator reliability. Presentations by utilities identified various generic causes of generator failure, the steps that need to be taken to deal with and correct these problems, and the future steps that need to be taken to minimize generator failures. Manufacturers were present at the Workshop to listen to and participate in the discussion of the utility presentations.

8150 **(TKK-KO/ET—10) Calculation of properties of refrigerants by computer.** Kivioja, K.; Fagerholm, N.-E. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1985. 36p. (In Finnish). NTIS (US Sales Only), MF A01. File Number DE87750396.

Property data of refrigerants is frequently needed in simulating various processes and analysing results of experimentation. Nowadays the calculations are without exception performed by computers. Hence it is essential that the properties can be obtained during computation without referring to tables or graphs. A computer program which calculates the properties of 12 most common refrigerants (R11, R12, R13, R14, R21, R22, R23, R113, R114, R500, R502, C318) was developed in our laboratory. The thermodynamic properties are calculated based on the Martin-Hou type equation of state and three other basic equations developed by prof. Martin and coworkers. Their interest in developing these equations were to present accurately also the experimental data at high densities. The equations to calculate the transport properties were obtained by fitting into general equations the property data of Du Pont, VDI and HEDH. The purpose was to be able to correlate the available data accurately in the temperature range of -20...100 deg C. The program was made in FORTRAN -77 programming language in the form of subroutine. So it can be called from any FORTRAN-program whenever property data is needed in the computation. The program calculates the properties of vapor and liquid in saturation state and the properties of superheated vapor. The desired state is defined by two state-properties (in this program pressure and temperature).

8151 **(TKK-S/ST—59) Preliminary study on failure diagnosis and performance monitoring in power plants.** Ruokonen, T.; Vaelisuo, H.; Lautala, P. (Helsinki Univ. of Technology, Otaniemi (Finland). Control Engineering Lab.). Mar 1985. 87p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750393.

The failure diagnosis and performance monitoring in power plants is dealt with. The failure mechanisms and the significance of the failures for reliability are examined and a survey on the diagnostic methods available is made. Also some parameter and state estimation methods and their use in failure diagnosis are presented. Failures of peat-fueled power plants are studied by interviewing operational personal at different types of power plants. Also statistics of failures and litterature on reliability and fault diagnosis are surveyed.

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REFER ALSO TO CITATION(S) 7890, 7912, 8470

8152 **(DOE/LC/00022—2164) Fossil Energy Waste Sampling and Characterization Project: Final report.** Jackson, L.; Moore, F. (Western Research Inst., Laramie, WY (USA)). May 1984. Contract AP20-84LC00022. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86006598.

An outline and explanation of the project organization, a complete description of all procedures used during the study, and a summary of all significant data are given. The breadth and depth of this report demonstrates the technical merits of the procedures, methods, and data. Technically, the FEWSCP develops a data base on the characteristics of fossil energy solid wastes. The project focused on wastes from conventional coal-fired electric utility plants with a brief look at a variety of emerging energy technologies.

8153 **(IVO-B—07/86) Preliminary study on the use of Doppler weather radar in short-range air pollution estimates.** Jylhae, K.; Saarikivi, P.; Koistinen, J.; Puhakka, T. (Imatran Voima Oy, Helsinki (Finland)). Aug 1986. 90p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750392.

Doppler weather radar opens up new possibilities of getting information about wind, precipitation and atmospheric turbulence required by air quality models over short distances. The capacity of weather radar for measuring accurately the three-dimensional structures of precipitation and clouds can be used to evaluate the efficiency of wet removal processes at different distances from the source. The measuring radius is 100-300 km and sea areas are covered as well as land areas. As a relationship between the rainfall intensity and the scavenging coefficient one can use either a power law based on the collection efficiency or an equation depending on the washout ratio and the depth of the wetted plume layer. Doppler weather radar measures the movement of scattering particles along the beam. From these Doppler velocities one can nearly immediately retrieve the vertical distribution of the wind speed and direction near the radar using the VAD method. At distances of more than 20 kilometers from the radar, the three-dimensional wind field can be determined using the VVP technique. To evaluate the wind field and turbulence one can use not only precipitation and cloud echoes but also clear air echoes. Utilizing the occurrence of clear air echoes and of ground clutter, the vertical distribution of the wind and the standard deviation of Doppler velocities it may also be possible to estimate the height of the atmospheric boundary layer.

8154 (KFK-PEF—4-Vol.3, pp 731-744) **Dry limestone and dolomite flue gas desulfurization: Improvement of sulfur dioxide sorption by optimum pore structure, by pelletizing and by chemical activation of the sorbent.** Weisweiler, W.; Hoffmann, R.; Stein, R. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Studies on desulfurization of flue gas were carried out in a laboratory fluidized bed reactor with dolomite, calcined dolomite, dolomite pellets and chemically activated dolomite pellets. By different methods of calcination (fluidized-bed or fixed-bed) one can change the pore structure of the solid to get a suitable sorbent for desulfurization depending on the flue gas temperature. For dolomite, calcined in a fluidized-bed, there exists an optimum of SO_2-sorption between 400 and 500°C. At 800°C the maximum sorption efficiency is obtained for dolomite calcined in a fixed-bed. Pelletization of dolomite powder increases the pore volume and the specific surface area which in turn enhances the sulfation capacity of the pellets.

8155 (KFK-PEF—4-Vol.3, pp 745-755) **Optimization of catalyst composition for selective catalytic reduction of nitrogen oxide by ammonia under transient conditions.** Kotter, M.; Lintz, H.G. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

A new NOsub(x) abatement strategy proposes the use of the Ljungstrom heat exchanger (Luvo) of the power plant as reactor, impregnating its surface by the catalytic active component. As the Luvo is rotating, being alternatively in contact with flue gas or clean air, this implies concentration cycling of the reactants and thus transient operation of the reactor. This transient behaviour has been simulated by use of a laboratory reactor. The catalysts used are of the impregnation type, based on oxides of vanadium and titanium. The catalytic activities obtained compare favourably with the values measured on bulk catalysts under stationary conditions. The results show that the sorption capacity of the catalyst for ammonia is an essential parameter in selective catalytic reduction of nitrogen oxides.

8156 (KFK-PEF—4-Vol.3, pp 777-796) **Simultaneous flue gas cleanup by means of electron beam.** Jordan, S.; Paur, H.R.; Schikarski, W. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The 'ES-Verfahren' is an electron beam dry scrubbing process by which NOsub(x) and SO_2 are removed simultaneously from flue gas. The oxidation of NOsub(x) and SO_2 yields the corresponding acids HNO_3 and H_2SO_4 which are then neutralized by NH_3, producing ammonium salts, which are removed by filtration.

8157 (KFK-PEF—4-Vol.3, pp 797-816) **Simultaneous flue gas cleaning (desulfurization, denitrification) by means of electron beams.** Wittig, S.; Spiegel, G.; Platzer, K.H.; Willibald, U. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

This phase of the research program reported here is primarily concerned with a systematic experimental and theoretical analysis of the importance of the dominant influence parameters. A gas fired burner serves to provide a base case with the opportunity to verify a broad range of gas compositions by mixing the gases under study to the main flow. It, therefore, is possible to investigate the interdependencies of the various gas components such as NOsub(x), SO_2, NH_3 etc. One major aspect of the experimental and theoretical work is the optimization of the energy utilization. The proper coupling of the flow with the radiation field is of dominant interest. Based on detailed field measurements, theoretical models are shown to be applicable to the description of the reactor. The importance of the results for the design of a pilot plant is indicated.

8158 (KFK-PEF—4-Vol.3, pp 863-880) **Determination of technical and economical strategies for emission reduction measures for sulphur dioxide and nitrogen oxides escaping from stationary sources in Baden-Wuerttemberg. Interim report 1986.** Rentz, O.; Haasis, H.D.; Remmers, J.; Schons, G. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

This project ascertains strategies for reducing emissions of sulphur dioxide and nitrogen oxides escaping from stationary sources in Baden-Wuerttemberg. The strategies are based on the real energy supply and production structure of Baden-Wuerttemberg and by this the indicated technical measures for emission re-

duction. For solving the conflict between energy conversion and emission reduction an optimizing energy-environment-model is used.

2003 Power Transmission And Distribution

8159 **(DOE/BP—730) Translations of electric power transmission materials in the Bonneville Power Administration library: A bibliography with indexes.** Gittings, M.J. (Bonneville Power Administration, Portland, OR (USA)). Nov 1986. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002957.

The Bonneville Power Administration library is responsible for procuring translations of foreign language materials into English upon request by agency personnel and maintaining a file of them. In addition, translations from other sources are collected if pertinent to the BPA mission. The subject of most of these materials is electric power transmission and related fields. This publication contains a register of translations on file together with Author, Journal, Source, and Subject indexes.

8160 **(DOE/RA/50153—T2) Study of electric field and ion effects of HVDC transmission lines. Final report.** (General Electric Co., Lenox, MA (USA). High Voltage Transmission Research Facility). Aug 1985. Contract AC02-80RA50153. 307p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86009836.

Full-scale HVDC line tests has provided data sufficient to estimate the electric field and ion environment within the right-of-way of HVDC lines. The electric field and ion environment at the edge of right-of-ways of HVDC lines can be estimated for conditions of calm wind and relatively small amount of aerosols, such as those occurring in rural areas. Transverse winds have a significant effect on the values of electric fields and ion densities, which increase downwind and decrease upwind. A method to evaluate wind effects within the right-of-way has been provided. The presence of aerosols has a significant effect on the electric field and ion density at the edge of the right-of-way and beyond. In addition aerosols may become charged, thus changing the quality of the electrical environment. The range of the electric fields and ion densities expected under HVDC lines can be evaluated applying the equations valid for saturated corona conditions. It was found that electric fields may reach values of 40 to 50 kV/m and ion concentrations may reach values of 100,000 ~ 150,000 ion/cm^3. These high values are reached only for short periods of time and in a small area close to the conductors at midspan. Both electric fields and ion concentration have large decays from the peak values to the edge of the right-of-way. At the edge of the right-of-way and beyond, the ion density may be significantly reduced because of the transfer of charges to aerosols.

8161 **(ECRC/R—2073) Weakening effect of two arrangements of preservative receptacle holes drilled into new wood poles.** Elcock, G. (Electricity Council Research Centre, Capenhurst (UK)). Jul 1986. 42p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK.

One option in the biological control of decay in wood overhead line poles is the insertion of capsules containing suitable chemicals. The extent of weakening of the poles due to the drilling of receptacle holes has been examined. 45 new poles were drilled using 2 alternative arrangements of 4 12.7mm dia. receptacle holes and subjected to breaking tests. Over the tested pole size range (200-250mm dia.) both drilling arrangements produced significant weakening for which allowances of from 5 to 15% may be required, but one hole geometry had a greater detrimental effect. Statistical assessment of the possible implications is made and appropriate derating factors for conservative adoption of either hole geometry arrangement are given.

8162 **(ERA—86-0038) Survey of mains signalling within the UK.** Bull, J.H.; Coleman, R.L.; Jackson, G.A. (Electrical Research Association, Leatherhead (UK)). Apr 1986. 83p. ERA Technology, Cleeve Road, Leatherhead, Surrey KT22 7SA, UK .

This report examines: the markets and types of mains signalling systems; classification of such systems; legislation; sensitivity of systems to interference; electrical noise affecting the systems; system immunity requirements. It is concluded that the mains signalling market is fluid, and new developments will occur frequently. There are clear indications that FSK (Frequency Shift Keying) systems will become dominant. Programmes of work are recommended which are intended to provide: a) necessary statistical information to regulatory and standards bodies; b) advice to manufacturers on the problems of interference; and c) a framework for classification of mains signalling systems to enable appropriate selection for particular applications.

8163 **(ORNL/Sub—85-00200/1) Measured electrical field data (TVA's 500 kV transmission lines) normalized and tabulated with terrain characterization parameters.** Simpson, T.L.; Brice, C.W. III. (South Carolina Univ., Columbia (USA). Coll. of Engineering). Oct 1986. Contract AC05-84OR21400. 398p. NTIS, PC E12/MF $7.30; 1; GPO Dep. File Number DE87002979.

This report presents a summary of the electric and magnetic fields measured by the Tennessee Valley Authority (TVA) in the vicinity of 500-kV extra-high-voltage (EHV) transmission lines. TVA sent measurement teams to collect field profile data at 2311 sites under 16 different lines in their system. This data was reviewed and ultimately stored on magnetic tape for further analysis. Microfiche data are included.

8164 **(PNL—5964) A technology transfer plan for the US Department of Energy's Electric Energy Systems Program.** Harrer, B.J.; Hurwitch, J.W.; Davis, L.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002839.

The major objective of this study was to develop a technology transfer plan that would be both practical and effective in promoting the transfer of the products of DOE/EES research to appropriate target audiences. The study drew upon several major components of the marketing process in developing this plan: definition/charcterization of the products being produced by the DOE/EES program, identification/characterization of possible users of the products being produced by the program, and documentation/analysis of the methods currently being used to promote the adoption of DOE/EES products. Fields covered include HVDC, new materials, superconductors, electric field effects, EMP impacts, battery storage/load leveling, automation/processing concepts, normal/emergency operating concepts, Hawaii deep water cable, and failure mechanisms.

21 NUCLEAR POWER PLANTS

8165 (IWG-NPPCI—86/1, pp 54-55) **National report - Belgium.** Vuylsteke, E.J. (Tractionel Nuclear Dept., Brussels, Belgium). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 8175, 8182, 8195, 8202, 8204, 8206, 8209, 8212, 8213

8166 **(CONF-8610135—13) Application of diagnostics to determine motor-operated valve operational readiness.** Eissenberg, D.M. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 15p. NTIS, PC A02. File Number DE87002627.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

ORNL has been carrying out an aging assessment of motor-operated valves (MOVs) with the primary objective of recommending diagnostic methods for detecting and trending aging. As a result

of experimental investigations at ORNL, it was discovered that the motor current during a valve stroke was a very useful diagnostic parameter for detecting and trending many MOV drive train load variations. The motor curent signatures were analyzed at four levels: mean value for a stroke, gross trends during a stroke, transients, and noise frequency spectra. Examples illustrating the use of this technique are presented. The use of motor current signature analysis was also shown to apply to other electric motor driven equipment. Future work includes developing a data base of MOV diagnostics, including criteria for determining the extent of degradation and application of the technique to other LWR motor driven safety equipment.

8167 **(NUREG/CR—4611) Trends and patterns in maintenance performance in the US nuclear power industry, 1980-1985.** Chockie, A.D.; Olson, J.; Bolton, P.A.; Winter, C.; Wheeler, W.A.; Geisendorfer, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 168p. (PNL—5859). NTIS, PC A08/MF A01 - GPO. File Number TI87002310.

This report presents an analysis of maintenance performance in the US nuclear power industry for the years 1980 through 1985. Using data derived from publicly available NRC sources, the analysis focuses on five performance categories that are directly influenced by the maintenance function. Trends over the six-year period are explored and performance differences are identified for BWR-PWR groups and for various categories of plant age (plants commercial prior to 1970, from 1970 to 1974, from 1975 to 1980, and 1980 or later) and size (plants with 599 MWe or less, 600 to 799 MWe, 800 to 999 MWe, and 1000 MWe or greater). The overall conclusions of this analysis are that (1) maintenance as a cause of plant problems may be becoming relatively more important, (2) average maintenance performance for the industry is improving along a number of important dimensions, and (3) this overall industry improvement can be attributed to improved maintenance performance in newer and larger plants. These newer and larger plants generally had poorer performance than the older and smaller plants for any given year, but have experienced the greatest relative improvement in their performance from 1980 to 1985. The older and smaller plants, on the other hand, generally had the best performance across the five categories, however, their level of performance between 1980 and 1985 remained relatively constant.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 8166, 8167, 8175, 8182, 8185, 8186, 8188, 8195, 8200, 8203, 8204, 8205, 8206, 8208, 8209, 8212, 8213, 8338

8168 **(DOE/ET/34030—11) Hot cell examination of extended burnup fuel from Fort Calhoun.** Garde, A.M. (Combustion Engineering, Inc., Windsor, CT (USA)). Sep 1986. Contract AC02-80ET34030. 140p. (CEND—427). NTIS (US Sales Only), PC A07/MF A01; 1; GPO Dep. File Number DE87002731.

The objective of the hot cell program, sponsored by the United States Department of Energy, the C-E Owners Group Utilities and Combustion Engineering and conducted by Combustion Engineering (C-E), was to examine the characteristics of fuel rods irradiated in Fort Calhoun after achieving rod-averaged burnups up to 56 GWd/MTU. The items investigated included the extent of fuel-cladding bonding and its relationship with the fuel rod growth, fission-gas release, fuel swelling, metallographic verification of waterside corrosion oxide layer thickness, extent of cladding hydrogen pickup and mechanical properties of extended burnup cladding. Descriptions of the fuel rod design, irradiation history and hot cell equipment and examinations are presented. The hot cell examinations included visual inspection, fuel rod puncture and gas analysis, measurements of rod void volume and interal pressure, gamma scanning, burnup analysis, fuel density measurements, cladding internal surface examination, metallographic examination of Zircaloy-4 cladding, ceramographic examination of UO_2 fuel, cladding hydrogen analysis and measurement of its burst and tensile properties.

2103 Power Reactors, Non-breeding, Graphite Moderated

8169 **(UNI-SA—186) Development and applications of core simulator for Hanford N Reactor.** Meriwether, G.H.; Skeen, D.R.; Erickson, D.G. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 1 Nov 1986. Contract AC06-76RL01857. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002688.

A sophisticated core physics analysis tool is required for implementing modifictions in operating strategies at the Hanford N Reactor. The code developed had to model the complex geometry of N Reactor, incorporate the control and safety systems, account for radial and axial fuel enrichment variation, provide the necessary reactivity feedbacks, and allow for fuel depletion and xenon tracking. A three-dimensional, two group, finite difference diffusion code, DELPHI, was developed, tested, and placed in use for this purpose. The size of the model forced the code to be developed on a Class VI computer (CRAY).

8170 **Exploitation of the very high temperature capability of the MHTGR to meet national energy needs after the year 2000.** McDonald, C.F. (Manager, Mechanical Engineering Group, GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). pp 273-280 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper addresses potential applications for the modular high-temperature gas-cooled reactor (MHTGR) to meet projected national energy needs early in the 21st century. The MHTGR reactor core is capable of up to 1000°C operation, which will evolve from the steam cycle base, together with the development of materials and components for elevated temperature service. The paper highlights roles of the advanced MHTGR for very high efficiency power generation and synthetic fuel production. Particular emphasis is put on the projected role of the MHTGR in the production of synthetic natural gas (SNG) that will be needed in several decades when natural gas resources are depleted.

8171 **Steam generator design considerations for modular HTGR plant.** McDonald, C.F.; DeFur, D.D. (GA Technologies Inc., P.O. 85608, San Diego, CA 92138). pp 281-286 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Studies are in progress to develop a standard High Temperature Gas-Cooled Reactor (HTGR) plant design that is amenable to serial production and is licensable. Based on the results of trade studies performed in the DOE-funded HTGR program, activities are being focused to emphasize a modular concept based on a 350 MW(t) annular reactor core with prismatic fuel elements. Utilization of a multiplicity of the standard module affords flexibility in power rating for utility electricity generation. The selected modular HTGR concept has the reactor core and heat transport systems housed in separate steel vessels. This paper highlights the steam generator design considerations for the reference plant, and includes a discussion of the major features of the heat exchanger concept and the technology base existing in the U.S.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 8200, 8216

8172 **Experimental and computational studies of the gamma-ray energy deposition rate in the Purdue Fast Breeder Blanket Facility.** Wang, T.K.; Clikeman, F.M.; Otti, K.O. (Purdue Univ., School of Nuclear Engineering, West Lafayette, IN 47907). *Nuclear Science and Engineering;* **93**: No. 3, 262-272(Jul 1986).

Experimental and computational studies of the gamma-ray energy deposition rate in the Fast Breeder Blanket Facility (FBBF) were performed with thermoluminescent dosimeters (TLDs). Various corrections including the TLD neutron sensitivities and the f factors (general cavity-ionization theory) were applied to the TLD measurements. Comparisons were made with results of three computer codes-1DX,2DB,and ANISN-and two nuclear libraries-LIB-IV and EPR. Both neutron and gamma-ray calculations were performed. The previously reported deviations between the gamm-ray energy deposition calculated-to-experiment (C/E) ratios for lead and for stainless steel were resolved. It is believed that the remaining C/E discrepancy comes primarily from the inaccuracies in the neutronics part of the calculations, because similar dropoffs are also reported in the FBBF reaction rate C/E comparisons. Detailed analysis of the deviation between transport (S/sub n/) and diffusion calculations in the FBBF were performed. It was found that the deviation is built up in the blanket region and is largely independent of the curvature of the "independent" source region. Comparisons between S/sub n/ and diffusion calculations (on a one-dimensional basis) for neutron fluxes and reaction rates indicated that the use of transport calculations should reduce the discrepancies of C/E comparisons.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 8246, 8247

8173 **(NUREG—0304-Vol.11-No.3) Regulatory and technical reports (Abstract Index Journal): Compilation for third quarter 1986, July-September.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Nov 1986. 62p. NTIS, PC A04 - GPO. File Number DE87900296.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors, as well as proceedings of conferences and workshops. The entries in the compilation are indexed for access by title and abstract, contractor report number, personal author, subject, NRC organization, contractor, and licensed facility.

8174 **(NUREG—0540-Vol.8-No.9) Title list of documents made publicly available, September 1-30, 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Nov 1986. 397p. NTIS, PC A17 - GPO. File Number DE87900164.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Source Index, Report Number Index, and Cross Reference to Principal Documents Index.

8175 **(NUREG/CR—4469-Vol.2) Nondestructive examination (NDE) reliability for inservice inspection of light water reactors: Semi-annual report, October 1984-March 1985.** Doctor, S.R.; Bates, D.J.; Charlot, L.A.; Good, M.S.; Hartzog, H.R.; Heasler, P.G.; Mart, G.A.; Simonen, F.A.; Spanner, J.C.; Tabatabai, A.S. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 100p. (PNL—5711-Vol.2). NTIS, PC A05/MF A01 - GPO. File Number TI87002466.

The Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactors Program at the Pacific Northwest Laboratory was established by the Nuclear Regulatory Commission to determine the reliability of current inservice inspection (ISI) techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this program include determining the reliability of ISI performed on the primary systems of commercial light-water reactors (LWRs); using probabilistic fracture mechanics analysis to determine the impact of NDE unreliability on system safety; and evaluating the reliability improvements that can be achieved with improved and advanced technology. A final objective is to formulate recommended revisions to ASME Code and Regulatory requirements, based on material properties, service conditions, and NDE uncertainties. The program scope is limited to ISI of the primary systems including the piping, vessel, and other inspected components. This is a progress report covering the programmatic work from October 1984 through March 1985.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 8197, 8198

2202 Components And Accessories

REFER ALSO TO CITATION(S) 8215, 8334, 8337, 8339

8176 **(NUREG—0040-Vol.10-No.3) Licensee contractor and vendor inspection status report: Quarterly report, July 1986-September 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Quality Assurance, Vendor and Technical Training Center Programs). Nov 1986. 211p. NTIS, PC A10/MF A01 - GPO. File Number TI87900163.

This periodical covers the results of inspections performed by the NRC's Vendor Program Branch that have been distributed to the inspected organizations during the period from July 1986 thru September 1986. Also, included in this issue are the results of certain inspections performed prior to July 1986 that were not previously reported.

2203 Fuel Elements

8177 **(DPST—86-271) Autoclave test of inertia welded slugs.** Peacock, H.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 27 Jan 1986. Contract AC09-76SR00001. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002644.

Inertia welding (IW) is being evaluated as an alternative to gas-tungsten-arc (GTA) welding, for welding Mark 31 slugs. To demonstrate IW, 40 production (GTA) slugs rejected for pinholes and poor bonds were used. After welding, the slugs were autoclave tested. No autoclave failures occurred. (DLC)

2204 Control Systems

REFER ALSO TO CITATION(S) 8205, 8206, 8207

8178 **(IWG-NPPCI—86/1) Tenth meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation, Vienna, 3-5 March 1986. Summary report.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Nuclear Power Plant Control and Instrumentation). Jul 1986. 74p. (CONF-8603160—Summ.). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227.

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation (IWG-NPPCI) was organized in order to summarize operating experience of NPP control systems, gain a general overview of activities in development of modern control systems and receive recommendations on the further directions and particular measures within the Agency's programme. The papers and discussions mostly dealt with practical experience and described actual problems encountered. Emphasis was placed on the technical, industrial and economic aspects of the introduction of modern, highly automated control systems and on the improvement of plant availability and safety. A separate abstract was prepared for each of the 20 presentations of the meeting.

8179 (IWG-NPPCI—86/1, pp 8-10) **Chairman report on the IWG-NPPCI activities May 1984/March 1986.** Bastl, W. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

A summary of the IWG-NPPCI activities in the past two years is presented. Meetings and training courses were held, publications were prepared and coordinated research programs were launched and discussed.

8180 (IWG-NPPCI—86/1, pp 10-14) **Report on NPPCI topics in the United Kingdom - March 1986.** Cox, R.J. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The author reviews the activities on nuclear power plant instrumentation and control topics in the United Kingdom. Since the last meeting of the Working Group in May 1984, the activities of the nuclear power industry in the United Kingdom has been dominated, firstly, by the Public Inquiry into the proposal to site a PWR at Sizewell in Suffolk - the public part of the Inquiry finished about a year ago having lasted eighteen months but the report is not now expected for some months. Secondly, all of the first generation of Advanced Gas Cooled Reactors have run up to power. Thirdly, the Prototype Fast Reactor at Dounreay is now reliably producing its design output of 250 MW(e) following major modifications to its steam generators. The new developments of the NPP simulators, computer control and instrumentation systems as well as reactor protection systems are briefly discussed.

8181 (IWG-NPPCI—86/1, pp 14-16) **Views on nuclear power plant control and instrumentation activities in Sweden.** Blomberg, P.E. (Studsvik Energiteknik AB, Nykoeping, Sweden). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The purpose of this presentation is to provide a summary of the activities concerning human errors in test and maintenance in nuclear power plants, implementation of the advanced information technology and expanded use of on-site conceptual plant simulators in Sweden. 1 fig.

8182 (IWG-NPPCI—86/1, pp 17-20) **Status summary report on operating experience and I and C concerns of nuclear power plants in Spain.** Cid, R.; Blasco, J. (Consejo de Seguridad Nuclear, Madrid, Spain). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The purpose of this presentation is to provide a summary of the topics concerning Instrumentation and Control systems of light-water nuclear power plants in Spain.

8183 (IWG-NPPCI—86/1, pp 20-26) **Recent movements and some topics on nuclear power plant control and instrumentation in Japan from 1984 to 1986.** Wakayama, N. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Reactor Instrumentation Lab.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

Extensive works have been carried out in Japan in the field of nuclear power plants control and instrumentation, and many fruitful results have been obtained. This paper aims to introduce such progress and topics obtained since 1984 in this field. 108 refs.

8184 (IWG-NPPCI—86/1, pp 27-31) **Activities carried out in Italy.** Di Bartolomeo, M. (ENEA, Rome, Italy). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

This paper summarizes operating experience and R and D activities in the field of Nuclear Power Plants Control and Instrumentation systems in Italy.

8185 (IWG-NPPCI—86/1, pp 32-34) **Instrumentation and control for nuclear power plants in Hungary.** Pellionisz, P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

This paper summarizes operating experience and R and D activities in the field of Nuclear Power Plant Control and Instrumentation systems with the WWER-440 power reactor in Hungary.

8186 (IWG-NPPCI—86/1, pp 35-37) **NPPCI - topics in the German Democratic Republic.** Ziegenbein, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

This paper summarizes research and development activities in the field of computerized operator support systems, self-powered detectors, boiling diagnostic and loose part detection systems in the German Democratic Republic. 11 refs.

8187 (IWG-NPPCI—86/1, pp 44-45) **NPPCI activities in Finland.** Wahlstroem, B. (Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

Research activities at the Technical Research Centre of Finland in the control and instrumentation field have been directed both towards immediate needs and towards long term goals. The immediate needs have been connected to different ongoing investigations and to development projects in connection with process industry. Of the more long term projects the following can be explicitly mentioned: the Nordic project on human reliability; work on software reliability; design guides for digital CI systems; simulation of technical processes; artificial intelligence in nuclear power. 2 refs, 1 tab.

8188 (IWG-NPPCI—86/1, pp 46-50) **National report on nuclear power plant control and instrumentation in Czechoslovakia.** Stirsky, P.; Karpeta, C. (Power Research Inst., Prague, Czechoslovakia). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

Research, development and design efforts in the field of nuclear power plant I and C systems in Czechoslovakia have been recently aimed at solving the following problems: setting the parameters of the WWER 440 units control and protection systems and testing them in the power phase of commissioning; design and simulation of the WWER 440 units control system performance under the conditions of steam bleeding for a centralized heat supply

system; development of a simulation model of the unit WWER 1000 dynamics for the purpose of I and C systems investigation and design; design of innovated I and C systems for WWER 440 and WWER 1000 units. 6 refs, 1 tab.

8189 (IWG-NPPCI—86/1, pp 50-53) **Instrumentation and control in the Canadian nuclear power programme: 1986.** Lepp, R.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

This paper gives a general overview of activities in development of modern control systems and reactor simulators for CANDU type reactors.

8190 (IWG-NPPCI—86/1, pp 55-57) **Report on nuclear power plant control and instrumentation topics in Austria 1984/1985.** Nedelik, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

This paper summarizes the activities in the field of reactor instrumentation and control in Austria. 7 refs.

8191 (IWG-NPPCI—86/1, pp 57-64) **Report on nuclear power plant control and instrumentation activities in the Federal Republic of Germany.** Bastl, W. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The overall situation in I and C of nuclear power plants in the Federal Republic of Germany can be characterized by three aspects. a) The improvement of man-machine communication by introducing integral information concepts for the control room by means of VDUs. b) Along with a) new data acquisition systems based upon process computers which facilitate the integration of operator aids like alarm analyses, disturbance analyses, post-mortem analyses, etc. c) The penetration of programmable processors into limitation systems in order to provide soft setback measures. d) The transition to I and C systems making use of the new generation of electronic components. The most important step towards advanced control rooms was the development of the Process Information System (PRINS) by KWU, which will be used with the German convoi-plants. The main emphasis regarding further R and D work in the field of operator aids is placed upon expert systems. Work will begin with a two years project aiming at the development of a basic module for a laboratory prototype. 2 figs, 1 tab.

8192 (IWG-NPPCI—86/1, pp 64-65) **Argentina's national report on nuclear power plant control and instrumentation.** Lorenzetti, J. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

8193 (IWG-NPPCI—86/1, pp 65-67) **Instrumentation and control in the Dutch nuclear power programme.** Visser, B.J. (Ministry of Social Affairs and Employment, Voorburg, Netherlands). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

A short review of the activities in the field of nuclear reactors in the Netherlands is given in this paper.

8194 (IWG-NPPCI—86/1, pp 67-68) **Fast controlled valving or how to improve nuclear power plant reactions on network disturbances.** Meulebroeke, F. van de. (Laborelec, Rhode Saint-Genese, Belgium). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

2205 Environmental Aspects

8195 (CONF-8610135—4) **Influence of moisture on the behavior of aerosols.** Adams, R.E.; Longest, A.W.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - GPO. File Number TI87002401.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The behavior of aerosols assumed to be characteristic of those generated during light water reactor (LWR) accident sequences and released into containment has been studied in the Nuclear Safety Pilot Plant (NSPP) located at the Oak Ridge National Laboratory (ORNL). It has been observed that in a saturated steam-air environment a change occurs in the shape of aerosol agglomerates of U_3O_8 aerosol, Fe_2O_3 aerosol, and mixed U_3O_8-Fe_2O_3 aerosol from branched-chain to spherical, and that the rate of reduction in the airborne aerosol mass concentration is increased relative to the rate observed in a dry atmosphere. The effect of a steam-air environment on the behavior of concrete aerosol is different. The shape of the agglomerated concrete aerosol is intermediate between branched-chain and spherical and the effect on the rate of reduction in airborne mass concentration appears to be slight. In a related project the shape of an agglomerated Fe_2O_3 aerosol was observed to change from branched-chain to spherical at, or near, 100% relative humidity.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 8201

8196 (NUREG/CP—0080-Vol.2, pp 1139-1144) **Prompt neutron decay constant for the Oak Ridge Research Reactor with 20 wt % ^{235}U enriched fuel.** Ragan, G.E.; Mihalczo, J.T. (Oak Ridge National Lab., TN). Aug 1986. NTIS, PC A24/MF A01 - GPO. File Number TI86901756. (CONF-860906—Vol.2). Contract AC05-84OR21400.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

This paper describes measurements of the prompt neutron decay constant at delayed criticality for the Oak Ridge Research Reactor (ORR) using 20 wt % ^{235}U enriched fuel and compares these measurements with similar measurements using 93.2 wt % ^{235}U enriched fuel. This reactor parameter is of interest because it affects the transient behavior of the reactor in prompt criticality accident situations. This experiment is part of a program to investigate the differences in the performance of research reactors fueled with highly enriched and low enriched uranium. The prompt neutron decay constants were obtained using noise analysis measurement techniques for a core with newly fabricated, unirradiated fuel elements.

8197 (NUREG/CP—0080-Vol.2, pp 1145-1156) **Measurements and calculations of ^{10}B(n,He) and ^{235}U(n,f) reaction rates in a control rod mockup in ZPPR.** Brumbach, S.B.; Collins, P.J.; Grasseschi, G.L.; Oliver, B.M. (Argonne National Lab., Idaho Falls, ID). Aug 1986. NTIS, PC A24/MF A01 - GPO. File Number TI86901756. (CONF-860906—Vol.2). Contract W-31-109-ENG-38;AC03-83SF11902.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

Results are reported for ^{10}B(n,He) reaction rate measurements inside B C pellets in a prototypic control rod mockup in the

Zero Power Plutonium Reactor. The helium accumulation fluence monitor (HAFM) technique was used, with absolute amounts of helium measured by isotope dilution mass spectrometry. Rates of ^{235}U fission were measured in foils irradiated between B_4C pellets. Both helium production and uranium fission rates were calculated using three-dimensional nodal transport methods. Average C/E values in the control rod were 0.961 +/- 0.034 for boron capture and 1.094 +/- 0.008 for uranium fission based on ENDF/B version V.2 cross sections. The C/E values were nearly constant in the rod interior but changed by a few percent near the rod tip. For both reactions, the C/E values were brought closer to unity by increasing the boron capture cross sections.

8198 **(ZJE—268) Neutron spectrum and flux density in a horizontal channel of the SR-0 reactor.** Hogel, J.; Vychytil, F. (Skoda, Plzen (Czechoslovakia). Zavod Jaderne Elektrarny). 1984. 11p. NTIS (US Sales Only), PC A02. File Number DE87900241.

Presented report describes the determination of neutron spectrum and flux density in the horizontal channel HK-1 of the experimental light water reactor SR-O. Measurements were performed with activation detectors. Some examples of using the SR-O reactor for irradiation experiments are given.

8199 **Benchmark assemblies of the Los Alamos critical assemblies facility.** Dowdy, E.J. (Los Alamos National Lab., Los Alamos, NM). pp 605-608 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Several critical assemblies of precisely known materials composition and easily calculated and reproducible geometries have been constructed at the Los Alamos National Laboratory. Some of these machines, notably Jezebel, Flattop, Big Ten, and Godiva, have been used as benchmark assemblies for the comparison of the results of experimental measurements and computation of certain nuclear reaction parameters. These experiments are used to validate both the input nuclear data and the computational methods. The machines and the applications of these machines for integral nuclear data checks are described.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 8538

8200 **(AEEW-R—1855) Use of dielectric heating in particulate bed dryout experiments.** Stevens, G.F.; Willshire, S.J. (UKAEA Atomic Energy Establishment, Winfrith. Safety and Engineering Science Div.). Sep 1984. 24p. Atomic Energy Establishment, Winfrith, Dorchester, Dorset, England. File Number TI86901180.

Decay-heated, liquid-saturated debris beds arise in hypothetical severe accidents with LMFBR and PWR, and a large international effort is currently engaged in experimental studies of the cooling limitations of such beds. Dryout is one of the important cooling limitations. Dielectric heating offers a means of closely simulating decay heating in beds of irregular particles, and is under development at AEE Winfrith for application to experimental studies of dryout. This report describes progress to date.

8201 **(DEMO—84/3) Whole core analysis of an open pool research reactor under the most severe loss of coolant accident conditions.** Bartzis, J.G. (Democritos Nuclear Research Center, Athens (Greece)). Jun 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900234.

In the present work the accident in which either the outlet or the inlet coolant pipe connected to the bottom of the reactor tank in an open pool research reactor is completely ruptured, has been analyzed. The 3-D transient computer code ThEAP-I, developed in NRC "Democritos" has been utilized and applied to the 5 MW Greek Research Reactor (GRR-1). The results show that for GRR-1 a partial melting of the reactor core is possible. The amount of melting is roughly and conservatively estimated to be of the order of 20%.

8202 **(EGG-M—22686) The status of the TRAC-BWR [Transient Reactor Analysis Code for Boiling Water Reactors Program.** Weaver, W.L. III; Johnson, G.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 14p. (CONF-8610135—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002603.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Transient Reactor Analysis Code for Boiling Water Reactors (TRAC-BWR) is being developed at the Idaho National Engineering Laboratory for the Division of Accident Evaluation, Office of Nuclear Regulatory Research of the United States Nuclear Regulatory Commission (USNRC). Several versions of TRAC-BWR have been released, the latest one being TRAC-BF1 which was released in June, 1986. The major new features of this code include a Courant-limit-violating numerical solution procedure in the one-dimensional components and a one-dimensional neutron kinetics model. Numerous other improvements also have been made to improve code accuracy and to decrease code running time. Before this code version was released, a series of developmental assessment test cases were executed. These developmental assessment test cases included seven separate effects test cases and five integral system test cases. The results of these test cases were included in the TRAC-BF1 code manual which was published in August, 1986. This paper will discuss the code improvements in TRAC-BF1 and present results of several of the developmental assessment test cases. The code development plans for FY-1987 will also be presented.

8203 **(EGG-M—30086) TMI-2 accident scenario update.** Tolman, E.L.; Kuan, P.; Broughton, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 17p. (CONF-8610135—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002615.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Estimates of the end-state core configuration have been developed from recent inspection of the lower regions of the TMI-2 core, core support assembly, and lower plenum regions. The inspection data have provided a basis for estimating the extent of damage to the core and core support structures and have confirmed that the migration pathway of the molten core material to the lower plenum occurred in the east quadrant of the reactor vessel. This paper integrates the core inspection data with other TMI-2 data and supporting analysis to update the best-estimate core damage progression scenario.

8204 **(EGG-M—34786) Effectiveness and safety aspects of selected decontamination methods for LWRs.** Duce, S.W.; Simpson, F.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 10p. (CONF-8610135—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002185.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

During the years 1984 and 1985 in-situ chemical decontamination processes were applied extensively in boiling water reactor (BWR) primary coolant recirculation systems (PCRSs) to help facilitate system replacement or inservice inspections, and more limited in pressurized water reactor (PWR) steam generators to facilitate tube plugging or sleeving operations. During these two years four chemical decontamination processes were observed: CAN-DECON, LOMI, DOW NS-1 and PNS CITROX A at a total of nine different facilities, seven BWRs and two PWRs. These chemical decontaminations were performed to reduce the man-rem that would be received by the work force to perform the specified task(s). This paper presents information and results on: (1) base metal attack during the process application; (2) methods used to protect critical components; (3) activity removed; (4) man-rem savings; and (5) waste forms and volumes.

8205 (IWG-NPPCI—86/1, pp 38-42) **French experience in using programmable systems for the control and the protection of nuclear reactors.** Jover, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Electronique et d'Instrumentation Nucleaire). Jul 1986. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The paper presents the results obtained in the use of two automated systems important to safety in 1300 MWE French nuclear reactors: the numerical integrated protection system (SPIN) and the logical control system (CONTROBLOC). 6 figs.

8206 (IWG-NPPCI—86/1, pp 42-43) **Report on the control and instrumentation of nuclear power plants in Switzerland.** Voumard, A. (Office Federal de l'Energie, Div. de la Securite des Installations Nucleaires, Wuerenlingen, Switzerland). Jul 1986. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

The paper presents the main activities intended to improve the control and the protection systems of nuclear power plants in Switzerland.

8207 (IWG-NPPCI—86/1, pp 68-73) **Qualification of C and I systems using new technology components.** Gossner, S. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). Jul 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700227. (CONF-8603160—Summ.).

From 10. meeting of the International Working Group on Nuclear Power Plant Control and Instrumentation; Vienna, Austria (3 Mar 1986).

Whereas one may find an almost complete change-over to microprocessor based automation and supervision systems in numerous industrial fields, a similar development did not yet take place in C and I systems of West German nuclear power plants. Neglecting some unimportant exceptions C and I systems of West German nuclear power plants are fully conventional. This situation, however, will not last forever. There is a growing understanding that by means of microcomputer-based C and I equipment it will be possible: to solve many problems more exactly, e.g. calculations of reactor power, power distribution, water levels, DNBR; to reduce the number of detailed informations and alarms concentrated in control rooms and control stations and to condense these informations into easily to understand pictorial displays, e.g. surveillance or trend pictures on graphic CRT-display units; to reduce cabling amount by using sequential data transmission, e.g. by means of bus-systems. It's clear in the near future microprocessors will enter not only operational C and I equipment but C and I systems important to safety as well. Therefore it's high time to analyse existing design and qualification requirements, qualification methods and qualification procedures whether or not to be suitable and sufficient. 2 figs.

8208 (NUREG—0876-Suppl.7) **Safety Evaluation Report related to the operation of Byron Station, Units 1 and 2 (Docket Nos. STN 50-454 and STN 50-455). Supplement No. 7.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Nov 1986. 87p. NTIS, PC A05/MF A01 - GPO. File Number TI87900121.

Supplement No. 7 to the Safety Evaluation Report related to Commonwealth Edison Company's application for licenses to operate the Byron Station, Units 1 and 2, located in Rockvale Township, Ogle County, Illinois, has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement provides additional information supporting the license for initial criticality and power ascension to full-power operation for Unit 2.

8209 (NUREG/CR—4522) **Closeout of IE Bulletin 79-21: Temperature effects on level measurements.** Dean, R.S.; Foley, W.J.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Nov 1986. 49p. NTIS, PC A03/MF A01 - GPO. File Number TI87900162.

On June 22, 1979, Westinghouse Electric Corporation reported to the NRC that elevated containment temperature could affect the reference leg water column and the indicated steam generator water level. IE Bulletin 79-21 was issued by the NRC on August 13, 1979 because of concern that the temperature effect could cause indication of erroneously high steam generator water levels, could delay or prevent protection signals and could cause incorrect information during post-accident monitoring. Because safety-related water level measuring systems used by Babcock & Wilcox and Combustion Engineering could be affected in the same way, the bulletin was issued for action to all utilities with operating pressurized water reactors (PWRS). The bulletin was issued for information to utilities with either PWRs under construction or operating boiling water reactors (BWRs). A related generic letter concerning BWRs was issued by the NRC in July 1979 for information only. Evaluation of licensees' responses and NRC/IE inspection reports shows that the bulletin can be closed out per specific criteria for all of the 41 facilities to which it was issued for action. It is concluded that utility responses were consistent because of guidance from the NSSS suppliers. Remaining areas of concern involve a possible need for manually deenergizing pressurizer heaters in B & W facilities, and further evaluation of boiling in the reference leg by Westinghouse.

8210 (PNL-SA—14104) **New method for presenting offsite radiological monitoring data during emergency preparedness exercises.** Moeller, M.P.; Martin, G.F.; Hickey, E.E.; Jamison, J.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76RL01830. 6p. (CONF-8609147—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002064.

From American Nuclear Society annual meeting; Bethesda, MD, USA (15 Sep 1986).

As scenarios for exercises become more complicated and flexible to challenge emergency response personnel, improved means of presenting data must be developed. To provide maximum realism and free play during an exercise, staff at the Pacific Northwest Laboratory (PNL) have recently devised a simple method of presenting realistic radiological field monitoring information for a range of possible releases. The method uses only two pieces of paper. The first is a map of the offsite area showing the shape of the plume for the duration of the exercise. The second is a semilog graph containing curves that relate exposure rate and iodine concentration to downwind distance and time. Several techniques are used to maximize the information on the graph.

8211 (SAND—86-0738C) **Equipment qualification testing evaluation experiences at Sandia National Laboratories.** Bustard, L.D.; Wyant, F.J.; Bonzon, L.L.; Gillen, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 9p. (CONF-860908—33). NTIS, PC A02/MF A01 - GPO. File Number TI87002697.

From Operability of nuclear power systems in normal and adverse environments meeting; Albuquerque, NM, USA (29 Sep 1986).

The USNRC has sponsored a number of programs at Sandia National Laboratories specifically addressing safety-related equipment qualification. The most visible of these programs has been the Qualification Testing Evaluation (QTE) program. Other relevant programs have included the Equipment Qualification Methodology Research Test program (CAP). Over a ten year period these programs have collectively tested numerous types of safety-related equipment. Some insights and conclusions extracted from these testing experiences are summarized in this report.

8212 (SAND—86-2115C) **Development and status of MELCOR.** Haskin, F.E.; Webb, S.W.; Summers, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 18p. (CONF-8610135—5). NTIS, PC A02/MF A01 - GPO. File Number TI87002490.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

MELCOR is a fully integrated, relatively fast-running code which models the progression of severe accidents in light water reactor nuclear power plants. An entire spectrum of severe accident phenomena is modeled in MELCOR. Characteristics of severe accident progression that can be treated with MELCOR include the thermal hydraulic response in the reactor coolant system, reactor cavity, containment, and confinement buildings; core heatup and degradation; hydrogen production, transport and combustion; core-concrete attack; heat structure response; radionuclide release and transport; and the impact of engineered safety features on thermal hydraulic and radionuclide behavior. MELCOR is being developed at Sandia National Laboratories for the US Nuclear Regulatory Commission (NRC) to succeed the Source Term Code Package. MELCOR has been designed to facilitate sensitivity and uncertainty analyses, and is currently being used to estimate severe-accident progression, source terms and associated sensitivities and uncertainties for two NRC-sponsored PRAs.

8213 **(SAND—86-2128C) MELCOR validation results.** Leigh, C.D.; Byers, R.K.; Shaffer, C.J. (Sandia National Labs., Albuquerque, NM (USA); Science and Engineering Associates, Inc., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 18p. (CONF-8610135—8). NTIS, PC A02/MF A01 - GPO. File Number TI87002495.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Recent comparisons of MELCOR predictions to three sets of experiments, the ABCOVE Aerosol Experiments, the HDR-V44 Steam Blowdown Experiments, and the Battelle-Frankfurt Gas Mixing Experiments are presentd. All three comparisons involve conditions that are of concern in an LWR containment during a severe accident. MELCOR results are compared to the experimental data and the predictions of at least one other state-of-the-art code for each test. In the ABCOVE comparisons, the MELCOR aerosol modeling is demonstrated. In comparisons to the HDR-V44 Steam Blowdown Experiments, MELCOR predictions of the response of the containment to the release of steam from the primary system are shown, and in the Battelle-Frankfurt comparisons, MELCOR predictions of the diffusion in a containment of an injected hydrogen-nitrogen gas are studied. These comparisons provide critical testing of the MELCOR control volume hydrodynamics package, the radionuclide package, and the flow path package.

8214 **Bayesian updating of seismic probability.** Lewis, H.W.; Seth, S. (Univ. of California, Dept. of Physics, Santa Barbara, CA 93106). *Nuclear Science and Engineering;* **93**: No. 3, 318-320(Jul 1986).

For those nuclear power plants for which a seismic probabilistic risk assessment has been conducted, it is possible to infer a prediction for the recurrence rate of the safe shutdown earthquake, and then to compare it with the historic seismicity at the site. Using the Bayesian algorithm, it is then possible to update the prediction in such a way as to quantify the degree of conservatism. By using a sample of eight plants, and other assumptions that are reasonable but by no means unique, the conservatism is estimated to be a factor of the order of 2 or 3. The uncertainty is also reduced, though there are caveats on this point. This suggests that earthquakes are somewhat overrated as sources of risk for nuclear power plants.

8215 **Level swell analysis of the Marviken Test T-11.** Grolmes, M.A.; Sharon, A.; Kim, C.S.; Pauls, R.E. (Fauske & Associates, Inc., 16W070 West 83rd Street, Burr Ridge, IL 60521). *Nuclear Science and Engineering;* **93**: No. 3, 229-239(Jul 1986).

A two-phase level swell will occur pressurizers, steam generators, and other types of nuclear plant equipment holding large volumes of saturated water in response to a pressure reduction such as would be encountered in a line break event or relief valve actuation. A simplified, but physically based one-dimensional model especially well suited to plant or system analysis is presented. Marviken test T-11 presents a unique source of data for confirmation of the analysis both in terms of the scale of the test itself and the number and variation of instrument locations.

8216 **An assessment of Clinch River Breeder Reactor core disruptive accident energetics.** Theofanous, T.G.; Bell, C.R. (Purdue Univ., School of Nuclear Engineering, West Lafayette, IN 47907). *Nuclear Science and Engineering;* **93**: No. 3, 215-228(Jul 1986).

A methodology is developed for the evaluation of the energetic consequences of postulated core disruptive accidents (CDAs), in liquid-metal fast breeder reactors. The methodology provides a framework for integrating the results of mechanistic analyses, including whole-core simulations (SAS, SIMMER), special effects analytical evaluations, and simulant material experiments into a probabilistic appreciation of accident evolution paths and respective likelihoods. Detailed quantitative results are presented for the Clinch River Breeder Reactor heterogeneous core design. As a result of this work, new perspectives were generated in the following areas: role of plenum fission gases, presence and role of small recriticalities in the early stages of core disruption, large annular and cylindrical pool recriticalities and associated disassembly yields, energy partition, and the role of structural response of vessel internal structures. The results indicate that a CDA-induced energetic vessel head failure is physically unreasonable.

25 ENERGY STORAGE

2501 Magnetic

8217 **Structural design of a utility scale Superconducting Magnetic Energy Storage plant.** Loyd, R.J.; Schoenung, S.M.; Nakamura, T. (Bechtel Group, Inc., San Francisco, CA 94105). pp 915-919 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Recent developments in the conceptual design of a Superconducting Magnetic Energy Storage (SMES) plant for utility load-leveling application have advanced the technology to a level where demonstration on a small scale would be an appropriate next step. In reaching this stage of development, numerous hurdles have been overcome. One of the most important of these is a reduction in operating stresses in the coil to acceptable levels, without the need for additional structural materials. This stress reduction to manageable levels is achieved by innovative structural design which decouples the major operating stresses.

2506 Thermal

REFER ALSO TO CITATION(S) 8290

8218 **Seasonal heat storage in unsaturated soils: Example of design study.** Nir, A.; Doughty, C.; Tsang, C.F. (Institute of Desert Research, Ben-Gurion Univ. of the Negev, Sede-Boker). pp 669-675 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Unsaturated soils are proposed as a preferred storage medium for low temperature heat storage applications. Their use is justified in warmer climates, in areas where shallow aquifers are not available or are needed for water supply. The use of unsaturated soils for heat storage presents a different set of problems than does the use of aquifers. The theory and proposed practice of unsaturated soil heat storage is discussed and a proposed storage-system design is presented. One of the key elements of the design is the maintenance of soil moisture conditions, which allows an approximate description of the storage system in terms of constant thermal parameters. The engineering aspects of this design are described and a mathematical model of the storage system is developed. The model is first verified against analytical solutions for simplified cases. Then several years of transient storage-system behavior are

simulated under differing charge and load conditions. The results indicate the range of operating conditions possible for this unsaturated soil heat storage system. Field experiments are proposed for the validation of the critical features of this model.

8219 **Chemical resistance of valve packing and sealing materials to molten nitrate salt.** Bradshaw, R.W. (Sandia National Labs., Livermore, CA 94550). pp 828-833 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Chemical compatibility between a number of compression packings and sealing materials and molten sodium nitrate-potassium nitrate was evaluated at temperatures of 288°C (550°F), 400°C (750°F), and 565°C (1050°F). The types of packing materials tested included graphite, asbestos, PTFE, aramid, glass and ceramic fibers; perfluoroelastomers, and boron nitride. Several materials were chemically resistant to the molten salt at 288°C, but the compatibility of packings at 400°C and 565°C was not adequate. The chemical and physical phenomena affecting compatibility are discussed and recommendations concerning materials selection are made.

8220 **Economical high temperature sensible heat storage using molten nitrate salt.** Tracey, T.R.; Scott, O.L.; Goodman, B. (Solar Energy Research Institute). pp 850-855 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Molten nitrate salt (60% NaNO/sub 3/, 40% KNO/sub 3/ by weight) is an excellent sensible heat storage medium because it has a high capacity per unit volume, low vapor pressure, and good heat transfer properties. It is also low in cost. The authors estimate the storage cost at $13/kWh/sub t/ at a storage size of 1200 MWh/sub t/. The molten salt working temperature limits of approximately 277°C (530°F) to 566°C (1050°F) are ideally suited to the generation and use of high-pressure, superheated steam for either electrical power generation or industrial process heat applications. A preliminary design and assessment of a prototype 1200 MWh/sub t/ storage system is described. The cylindrical tanks contain 23,100,000 lb of salt and are about 83 ft in diameter and 50 ft high. The hot-tank design uses a unique internal insulation design consisting of 13.5 in. of low-density insulating brick between a flexible internal liner and the carbon steel shell. To demonstrate the concept, a subsystem research experiment (SRE) was designed, built, and tested. The 6.9 MWh/sub t/ SRE, which contains 174,000 lb of salt, has been in operation for 4 years. The scaling rationale is discussed along with the design, fabrication, and test results. The conclusion of this work is that the storage system has been demonstrated and has potential to be one of the most economical high temperature systems available.

8221 **High temperature composite thermal energy storage (TES) systems for industrial applications.** Petri, R.J.; Ong, E.T.; Martin, J. (Institute of Gas Technology, Chicago, IL 60616). pp 873-880 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

An advanced, thermal energy storage (TES) subsystem is being developed by the Institute of Gas Technology (IGT) under the sponsorship of the Department of Energy (DOE) through Oak Ridge National Laboratory (ORNL). This subsystem employs a family of composite phase change material (PCM)/sensible heat media (CompPhase). The basic- and engineering-research efforts have focused on the development of these media for low (400°F) and high (900° to 2500°F) temperature regimes. As such, the media subsystem is amenable to high temperature storage applications such as industrial reject/process heat recovery and utilization, off-peak utility, solar thermal, solar chemical and fuels, and space solar dynamic power systems. The CompPhase concept allows for direct contact heat exchange between the latent/sensible storage media and compatible working fluids. A number of potentially significant performance and cost advantages are thereby offered over conventional tube-intensive indirect contact molten salt latent-heat-based storage systems.

2509 Batteries

8222 **(SAND—86-2248C) Lithiation of FeS_2 for use in thermal batteries.** Guidotti, R.A.; Reinhardt, F.W. (Sandia National Labs., Albuquerque, NM (USA). Battery Development Div.). 1987. Contract AC04-76DP00789. 9p. (CONF-870111—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001417.

From Annual battery conference on application and advances; Long Beach, CA, USA (13 Jan 1987).

The inability of the standard Sandia catholyte to meet the discharge requirements of a 60-min, Li(Si)/FeS_2 long-life thermal battery (LLTB) necessitated the development of a new catholyte based on lithiated FeS_2. Lithiation of FeS_2 by Li_2S, Li alloys, and Li_2O was examined under various processing conditions and the resulting catholytes were tested in a half-size, 5-cell battery. The best overall results were achieved with Li_2O-lithiated catholytes. The optimum compositions were successfully tested in the full-size LLTB. The excessive, initial voltage transient normally observed was totally eliminated and the pulse performance near the end of life was dramatically improved.

8223 **The flexpower zinc-chloride battery: 1986 update.** Whittlesey, C.C.; Singh, B.S.; Hacha, T.H. (EDA, Inc., 200 E. Seneca Road, Greensboro, NC 27406). pp 978-985 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The development of zinc-chloride battery technology for electric-utility applications has been the principal focus of EDAs activities for the past three years. In 1983, EDA built, qualified, and installed a 500-kWh, 100-kW battery system at the Battery Energy Storage Test (BEST) Facility. Successful testing, conducted by utility personnel, was completed in November 1984, the battery having delivered in excess of 50 MWh dc. EDA has designed commercial hardware, sized at 2 MW, 6 MWh, based on the stack technology employed so effectively in the BEST Facility test. In this 2 MW FLEXPOWER technology, sixteen 125-kW stack/sump modules and a single chlorine-hydrate store form the battery subsystem. EDA has built and tested the prototype 125-kW module. In start-up testing, this exceeded the specifications for power, energy, and dc-dc efficiency. Based on (a) the successful 125-kW system test; (b) detailed specifications for the factory-skidded subsystems; and (c) favorable studies of reliabiity/availability, environmental/safety,and costs, EDA is now poised to build the first 2 MW FLEXPOWER unit - a technology demonstration for the electric-utility industry.

8224 **Battery requirements for urban electric vans.** Patil, P.G.; Walsh, W.J. (U.S. Dept. of Energy). pp 1034-1040 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The Department of Energy (DOE) has carried out an intensive study of battery requirements for electric vans, and developed a mission-directed goals package for each of the principal battery contenders for this application. These goals were based on the assumption that vehicle range and acceleration must be fully met throughout each battery discharge. Under this assumption, the design point is the end-of-life condition, defined as the last cycle in which both power and energy requirements can be fulfilled. A light-weight, low-rolling-resistance van with an improved version of the ac powertrain being developed by Eaton was chosen as the hypothetical baseline vehicle. A modified FUDS cycle was selected along with assumptions of 3 M/sup 2/ frontal area, 0.37 drag coefficient, and a rolling resistance of 0.008. State of art characteristics

and design interrelationships were developed for each battery technology, and the degree of advance expected by 1995 was projected. For each battery candidate, a least-cost combination of performance and operating characteristics was determined. The analysis included the peak power vs. specific energy and depth-of-discharge (DOD), cycle life vs DOD, cost vs. onboard energy and power, and kWh size effects. The resultant R&D goals for the electric van battery are presented, including early-in-life and end-of-life energy over the drive cycle, peak power, batter weight and volume, battery life, costs, and allowable frequency of repair.

8225 **The present status of aluminum/air battery development.** Scamans, G.M.; O'Callaghan, W.B.; Fitzpatrick, N.P.; Hamlen, R.P. (Alcan International Ltd., Banbury, Oxon OX16 7SP). pp 1057-1061 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Important advances have recently been made that are relevant to the successful development of aluminum/air batteries. These have included the improvement of electrolyte management techniques either to extend electrolyte lifetime by modifying reaction product precipitation or by the use of an external crystalliser to promote precipitation so as to maintain a controlled electrolyte conductivity. In addition air electrodes are now available that are matched to present battery application requirements both in terms of performance and cost and aluminum anodes have been developed with improved polarisation and corrosion characteristics. The latter development being accelerated by improved understanding of the anode activation process and its relationship to alloy composition and microstructure. This paper presents a review of these advances in the areas of electrolyte management and anode development, particularly for traction battery applications.

8226 **Feasibility study of a new zinc-air battery concept using flowing alkaline electrolyte.** Ross, P.N. Jr. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA 94720). pp 1066-1072 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC03-76SF00098.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Proof-of-principle experiments are reported for a new concept in electrically rechargeable zinc-air battery. The zinc electrode is a porous flow-thru type using a copper foam metal substrate with zinc deposition onto the foam metal from concetrated zincate electrolyte (as used in zinc-slurry type batteries). The bifunctional air electrode employs low-cost materials, being fabricated entirely from carbon-based precursors and small amounts of nickel and/or cobalt oxide. Corrosion measurements on the graphite materials in the air electrode indicate sufficient corrosion resistance for 8000 hr life on charge. A prototype single cell was constructed having 1.5 Ah capacity producing 1.2 V discharge -2.0 charge at the three hour rate and has produced stable voltages for more than 150 cycles. Based on the 1.5 Ah prototye characteristics, design calculations were made for a 32 kWh battery. These calculations project an energy density of about 110 Wh/kg, peak power density of 140 W/kh, electrical efficiency of 60% and attractive materials cost of ≦ $20 per kWh.

8227 **Development of zinc-bromine batteries for stationary energy storage applications.** Leo, A.; Albert, G.; Bilhorn, M.; Chi, C.; VanSchalkwijk, W. (Energy Research Corp.). pp 992-998 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Recent activities and results in the ERC zinc-bromine battery development program are presented. The paper describes the battery concept and operating characteristics. The background is described along with a discussion of program activities presently underway. Performance characteristics of small cells, large single cells and multi-cell stacks are presented and discussed. Results of preliminary design studies on full-size utility battery systems are presented.

8228 **A stable, high performance lithium/iron disulfide cell with LiCl-LiBr-KBr molten electrolyte.** Kaun, T.D. (Argonne National Lab., Chemical Technology Div., Argonne, IL 60439). pp 1048-1051 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract W-31-109-ENG-38.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A stable Li-Al/FeS/sub 2/ cell with a greater than 50% increase in specific energy and specific power has been developed at Argonne National Laboratory. This cell has two major changes from earlier cells of this type: (1) a novel electrolyte, and (2) a higher loading density (2.4 vs. 1.5 Ah/cm/sup 3/) for the FeS/sub 2/ electrode, which is then operated only on its higher voltage plateau (1.75 V vs. Li-Al). This cell design is designated "dense upper-plateau (U.P.) FeS/sub 2/ cell" to distinguish it from the conventional "two-plateau (T.P.) FeS/sub 2/ cell." The new electrolyte permits reduced operating temperatures of 380-420°C. Conventional cells are operated in a temperature range of 425-460°C. The use of the dense U.P. -FeS/sub 2/ electrode and the lower melting LiCl-LiBr-KBr electrolyte has eliminated the capacity-loss problem of the Li-Al/FeS/sub 2/ system. A dense U.P. -FeS/sub 2/ electrode cell had no change in capacity utilization (about 89%) after 400 cycles (5400 h) of operation. with LiCl-KCl electrolyte, a FeS/sub 2/ cell would have lost 30% of its capactiy in the first 200 cycles. Based on the improved perforamnce, advanced cell designs are expected to achieve a specific energy of 175 Wh/kg at 4-h rate and a specific power of 200 W/kg at 80% depth of discharge.

8229 **Customer-side-of-the-meter battery storage: Technology transfer strategy.** Quinn, J.E.; Hurwitch, J.W. (U.S. Dept. of Energy, Washington, DC 20036). pp 1004-1011 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper explores the technical and economic issues of customer-side-of-the-meter battery storage as a demand-side load management option and describes the current status of efforts to commercialize this technology. Current advanced lead-acid battery technology is available for applications ranging from 500 kWh to 10 MWh. Results of analyses by the U.S. Department of Energy (DOE) and the Electric Power Research Institute (EPRI) have shown that applications on the customer side are cost-effective in some circumstances. The conditions that are most important indetermining the attractiveness of the technology include short, sharp demand peaks by customers, high demand charges by the local utility, and ready availability of operating and maintenance personnel. This technology also provides the advantages of attractive utility dynamic (spinning reserve) benefits, reduced transmission and distribution requirements, emergency backup for the user, and relatively short lead times in installation. Several uncertainties need to be reduced before the option is attractive to a wide spectrum of users. These uncertainties include reliability of the battery and power conditioning technology, development of effective control equipment and software, ratcheting effects in utility rates, control of the battery system, safety requirements and licensing needs.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 8244, 8258, 8300

8230 (ESC-WR—86-03) On the use of interactive multi-objective linear programming methods for long term energy planning. Kok, M.; Van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). Apr 1986. 22p. (CONF-8603166—1). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 23. meeting Euro working group on multiple criteria decision support; Rotterdam, Netherlands (20 Mar 1986).

This paper is concerned with an applicability of multi-objective methods in long term energy planning. The methods are useful in decreasing the uncertainties related to imperfect representation of the decision making process. First the policy issues, main reasons for diversity and complexity of the decision making process, are described. Furthermore the energy model and adopted method of research are briefly introduced. Next the results with multiple objective methods are discussed. Finally, the evaluation shows clearly the many policy issues, where the decision makers agree and where they disagree. 3 figs., 5 tabs., 20 refs.

8231 (ESC-WR—86-04) Sensitivity analyses of electric power generation in energy models for The Netherlands, 1986. Boonekamp, P.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1986. 43p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Energy Study Centre of the Netherlands Energy Research Foundation ECN is responsible for drawing up energy scenarios for The Netherlands on basis of energy price scenarios of the Ministry of Economic Affairs and energy demand scenarios of the Central Planning Bureau. This has resulted in three energy-environment scenarios for 1986. The parts dealing with electric power generation have been drawn up before the Chernobyl accident. As a result of this accident the assumption that a third of the electric power in the years 2000 and 2010 will be generated by nuclear power plants looks unrealistically now. Nevertheless the presented sensitivity analyses, which have been done, give a clear insight into the possibilities and financial risks of differently composed electric power generation sectors and the effects of different load demand curves. 21 tabs.

8232 (ESC-WR—86-09) Analysis of the sector petroleum refineries in energy scenarios for The Netherlands. Van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jul 1926. 28p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The calculations with regard to the oil sector in general and the petroleum refineries in particular of the energy scenarios for The Netherlands are described. Calculations have been made with the help of the energy models SELPE and SERUM, developed for the total energy scene of The Netherlands and the petroleum refineries respectively. The results of the calculations with respect to the petroleum refineries are compared. This resulted in adjustment of the parameters for the oil sector in the SELPE energy model and the consequences of these adjustments for the energy scenarios for The Netherlands. 3 figs., 15 tabs., 10 refs.

8233 (ESC-WR—86-15) Dutch energy scenarios: renewable energy sources. Bakema, G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1986. 50p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

As part of the development of Dutch energy scenarios for the years 2000 and 2010 energy supplies by renewable energy sources have been studied. Contributions are taken into account from wind power, centralized as well as decentralized power generation, water power, solar energy, geothermal energy and energy from wastes. The contribution to the electric power generation capacity will increase from nearly zero in 1985 to 4.5-6% in 2000 and to 10-12% in 2010. The contribution which will be actually realized is lower because wind power capacity cannot be utilized fully and therefore will vary between 2.6 and 7.1%. For the calculations the energy model SELPE, which optimizes costs for energy supplies, has been used. 5 figs., 35 tabs., 10 refs.

8234 (NP—7750363) MARKAL - a model for energy systems. (Statens Energiverk, Stockholm (Sweden)). 15 Apr 1986. 71p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750363.

The report describes the results of a collaboration between the Joint Council of the Major Swedish Electric Power Producers, the Energy Research Commission and the National Energy Administration in order to test a model for energy systems called MARKAL. MARKAL is a linear programming model and used i.e. to compare different energy sources used in a national energy system. The test showed that MARKAL gave almost the same result as the models for electricity distribution systems now used by the power producers.

8235 (OEFZS-A—0856) Sensitivity study with the computer program MARKAL. Pfau, H.; Sonneck, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Reaktorsicherheit). Aug 1986. 73p. (In German). (RS—275/86). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

Limited distribution.

The planning how to meet a given demand of energy will be made increasingly using formalized mathematical models. Presently the computer program MARKAL is used for the Austrian energy concept. The discussion on the input data will become more efficient and lead to better results the more it is restricted to the essential points. As a contribution to solve this problem a sensitivity analysis for the subsystem 'public electricity supply' was made. Starting from a sufficiently realistic input deck it was investigated in which way relatively big changes of a number of input parameters influence the optimal solution. Using minimum system cost as the objective function the results show that the solution is surprisingly stable. This is mainly due to the comparatively big role of hydroelectricity in the Austrian electricity supply.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 7944, 7955, 8003, 8012, 8063, 8106, 8128, 8244, 8250, 8313

8236 Biotechnology: Potential impact and issues. Busche, R.M.; Hardy, R.W.F. (E.I. du Pont de Nemours and Co., Wilmington, DE 19898). pp 651-673 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

Major targets for new products in biotechnology are discussed among the market sectors: healthcare, animal and crop agriculture, food ingredients, industrial chemicals, energy, forestry, pollution control, mining, and bioelectronics. The expected impact on these markets and introductory timing among developed, developing, and centrally planned economies are evaluated from the responses of a limited number of experts in these areas. Major impacts in healthcare should be felt early in the 1990's, while innovations in agriculture will lag by five to ten years. Introductory timing for other market categories appears beyond the year 2000. 43 refs., 4 figs., 12 tabs.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 7934, 8003, 8158, 8561, 8565, 8581, 8601, 8626, 8644

8237 **(NP—7750299) Environmental research and environmental technology. Program 1984-1987.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1984. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750299.

The introducing chapter of the leaflet abstracted is dedicated to the aims and responsible institutions of environmental research based on a far-sighted environmental policy. It points out the results of recent promotion programs, future priorities and future vehicles of promotion. Another chapter deals with ecological research and points out the effects of human interventions into selected environmental sectors. It discusses the pollution of the ground, the water balance, effects of air pollution and forests and other ecosystems, methodological aspects, the scheming of models, balancing of chemical substances contained in the atmosphere and a base of environmental samples. Moreover, the paper points out technologies to minimize environmental loads in the fields of water resources and waste management, air pollution abatement, noise pollution abatement and sea pollution abatement. Low-emission technologies and products are explicitly made the prior object of research. The annex contains a survey of medium-term financial planning as well as a survey of the control aims and projects of the AGF (Arbeitsgemeinschaft der Grossforschungseinrichtungen/research center association) and a survey of managing institutions. (HSCH).

8238 **(PB—87-100319/XAB) Transportation of hazardous materials.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1986. 377p. (OTA-SET—304). NTIS, PC A17/MF A01.

Library of Congress catalog card no. 86-600542.

This report discusses the following: data and information systems for hazardous-materials; containers for hazardous-materials transportation; hazardous-materials transportation regulation; and training for hazardous-materials transportation enforcement and emergency response.

8239 **(PB—87-101838/XAB) NIOSH (National Institute for Occupational Safety and Health) pocket guide to chemical hazards.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1985. 257p. (DHHS/PUB/NIOSH—85-114). NTIS, PC A12/MF A01.

The NIOSH Pocket Guide to chemical hazards is presented. The guide contains information taken in part from NIOSH or OSHA occupational health guidelines for chemical hazards. Data were also obtained from recognized text books in the fields of industrial hygiene, medicine, toxicology, and analytical chemistry, and articles from a variety of technical journals. The guide was developed as a means for making information contained in the NIOSH or OSHA guidelines more conveniently available to workers, employers, and occupational health professionals. It presents key information and data in an abbreviated tabular format for 397 individual chemicals or chemical types found in the work environment and for which there are specific Federal regulations. Information contained in the guide includes: chemical names and synonyms, exposure limits and recommendations, chemical and physical properties, analytical methods, respirator and personal protective equipment recommendations, signs and symptoms of exposure, and procedures for emergency treatment.

8240 **(PB—87-108072/XAB) Survey of household hazardous wastes and related collection programs. Final report.** Mitchell, G.L.; Demichelis, D.M.; Marshall, J.D.; Flaherty, S.F. (SCS Engineers, Inc., Long Beach, CA (USA)). Oct 1986. 134p. NTIS, PC A07/MF A01.

The report summarizes the results of a study that addressed: the definition of household hazardous wastes (HHW); the quantities of HHW in the municipal-waste stream; the impacts of HHW on homeowners, solid-waste collection and disposal personnel, and the environment; and HHW collection programs conducted at State and local levels. A standard definition of HHW was developed and lists of household products that may be considered HHW, when discarded, are given. Several instances of injuries to sanitation workers resulting from handling HHW are documented. Information on State and local HHW collection programs is given, including the benefits and problems associated with these programs.

8241 **(UCID—20720-Pt.1) US Department of Energy Comprehensive Environmental Response Compensation and Liability Act Program, DOE Order 5480.14: Lawrence Livermore National Laboratory Phase 1, Installation assessment: Phase 1, Site 300.** Lindeken, C.L.; Loftis, J.A.; Ragaini, R.C. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002740.

The purpose of this assessment is to document the identification and location of those inactive disposal sites at Lawrence Livermore National Laboratory's (LLNL) Site 300 that may pose an undue risk to health, safety, and the environment as a result of migration of hazardous substances from the disposal sites. The scope of this report is limited to the Phase I Assessment of five locations at LLNL's Site 300 in accordance with DOE Order 5480.14. This report includes the results of the investigation conducted through March 1986.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 7928, 8003, 8063, 8115, 8116, 8126, 8130, 8164, 8395

8242 **(BNL—38850) Brookhaven National Laboratory technology transfer report, fiscal year 1986.** (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002830.

An increase in the activities of the Office of Research and Technology Applications (ORTA) is reported. Most of the additional effort has been directed to the regional electric utility initiative, but intensive efforts have been applied to the commercialization of a compact synchrotron storage ring for x-ray lithography applications. At least six laboratory technologies are reported as having been transferred or being in the process of transfer. Laboratory accelerator technology is being applied to study radiation effects, and reactor technology is being applied for designing space reactors. Technologies being transferred and emerging technologies are described. The role of the ORTA and the technology transfer process are briefly described, and application assessment records are given for a number of technologies. A mini-incubator facility is also described. (LEW)

8243 **(CONF-861211—15) Issues in transferring US energy technologies to developing nations.** Wilbanks, T.J.; Brown, M.A.; Samuels, G. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001701.

From American Society of Mechanical Engineers winter meeting; Anaheim, CA, USA (7 Dec 1986).

To stimulate discussion of potentials for and mechanisms of technology transfer from the US to developing nations, this paper draws upon two bodies of experience at ORNL: (1) a wide variety of technical assistance activities supported by the US Agency for International Development (AID), helping AID-assisted developing nations improve their energy planning, policy formulation, and applications of fossil and renewable energy options; and (2) a wide variety of technology transfer related activities, ranging from (1) assistance to buildings energy conservation programs of the US Department of Energy in improving the transfer of new technologies from the nation's R and D system to commercial users to (2) research to improve the general understanding of the technology transfer process, especially from R and D institutions to commercial developers. Using three energy options of current interest to AID as examples (carbonized coal briquettes to meet residential and commercial sector energy needs, wood gasification to power stationary internal combustion engines, and rural electrification), the paper illustrates the importance of several dimensions often neglected in engineering-economic analysis, such as institutional re-

quirements and a relatively detailed understanding of market segments. Unless such dimensions are incorporated effectively into technology transfer efforts by US developers, relatively little success should be expected either in expanding markets for US technology or in helping developing nations meet their energy needs.

8244 **(ESC-WR—86-08) Energy research scenarios. Report of the first phase: Systems studies.** Van Arkel, W.G.; Boswinkel, H.H.; Gerbers, D.; Kram, T.; Midden, C.J.; Okken, P.A.; Over, J.A.; Roemer, J.C.; Tiemersma, D.N. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jun 1986. 92p. (In Dutch). (EOS—34). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

To provide for a solid basis for long term policy on energy research in The Netherlands the Energy Study Centre of the Netherlands Energy Research Foundation ECN has set up a study. Purpose of the study is identifying research areas, in the field of energy supplies, that look promising for The Netherlands in the future. The study has been divided into five parts; results of the first part are reported and deal with preparatory activities on energy systems analyses. An important aid has been the computer program MARKAL which uses linear programming for optimization of energy supplies. The periods which are covered are 1980-2020 and 2010-2050. The studies conducted in the first (out of five) part are concerned with, for instance, information on production costs of energy sources, availability for The Netherlands and prices which have to be paid. Similar studies are conducted for future environment protection requirements, techniques used in the energy- and environment fields, and the development of energy demand. Three normative energy scenarios with global effects and consequences for The Netherlands have been developed. The activities for the second part (out of five) of the study are outlined. It deals with the period 1980-2020. 21 figs., 14 tabs., 34 refs.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 7961

8245 **(DOE/S—0054) Energy Research Advisory Board, Civilian Nuclear Power Panel: Subpanel 3 report, Institutional challenges: Volume IV.** (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). Oct 1986. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002987.

The Institutional Challenges Subpanel of the Energy Research Advisory Board's Civilian Nuclear Power Panel was charged with the task of addressing the institutional issues that affect the future of nuclear power in the United States. Barriers created by non-technical issues are generally considered to be primary obstacles to revitalizing the nuclear fission option as part of a robust supply for future electrical generation. The Subpanel examined the following categories of institutional issues: (1) Administration Policy and Leadership, (2) Licensing Reform, (3) Standardized Designs, (4) Shared Financial Risk, (5) State and Economic Regulation, (6) Waste Disposal, and (7) Public Perception. The Subpanel concluded that the Administration and Congress have the opportunity and responsibility to provide leadership in resolving these difficulties. The main report provides information on the background and current situation for each institutional issue and concludes with the set of recommendations for action.

8246 **(NUREG—0325-Rev.9) US Nuclear Regulatory Commission functional organization charts.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). 30 Nov 1986. 56p. NTIS, PC A04 - GPO. File Number DE87900247.

Functional organization charts for the NRC Commission Offices, Divisions, and Branches are presented.

8247 **(NUREG—0940-Vol.5-No.3) Enforcement actions: Significant actions resolved: Quarterly progress report, July-September 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Nov 1986. 413p. NTIS, PC A18/MF A01 - GPO. File Number TI87900120.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (July to September 1986) and includes copies of letters, notices, and orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions and the licensee's responses. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, in the interest of promoting public health and safety as well as common defense and security.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 8311

8248 **(NP—7750367) Development of district heating 1983-1995.** Gorpe, P.; Enqvist, J.; Borchers, M. (Statens Energiverk, Stockholm (Sweden)). 4 Feb 1985. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750367.

This report describes the development of district heating in Sweden. The following aspects are discussed more in detail: The method used to estimate the future increase. The economy compared to other systems. The potential and prognosis of extension. Use of different energy sources, the consequences, such as less oil consumption and pollution as well as production of electricity in local heat plants.

8249 **(NP—7900037) Wisconsin energy statistics, 1986.** Samuel, B. (ed.). (Wisconsin Div. of State Energy and Coastal Management, Madison (USA)). Jun 1986. 137p. Wisconsin Division of State Energy and Coastal Management, Department of Administration, PO Box 7868, Madison, WI 53707. File Number TI87900037.

The statistics in this report are organized as follows: Chapter 2 presents Wisconsin's total use of energy resources, disaggregated by fuel type and by economic sector (i.e., residential, commercial, industrial, electric utility, agricultural, and transportation sectors). Chapter 3 contains more detailed statistics grouped by fuel type (petroleum, natural gas, coal and electricity). Chapter 4 is the expanded section on renewable energy resource use and energy conservation activity. Chapter 5 provides basic data for United States energy use, and compares United States and Wisconsin per capita energy use. Chapter 6 presents Wisconsin prices of fuel and power for different economic sectors. Chapter 7 shows Wisconsin's annual expenditures for energy, disaggregated by type of fuel and by economic sector. Chapter 8 lists miscellaneous data related to energy use, including demographic data and heating degree days.

2910 Conservation

8250 (CONF-8508111—Vol.2, pp 68-76) **Conservation program marketing design and evaluation.** Mystakides, E. (Arthur D. Little, Inc., Cambridge, MA). 1985. NTIS, PC A15/MF A01. File Number DE86011426.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

Conservation program managers face a wide range of options for the evaluation of program accomplishments. A key - and often overlooked - factor in a successful evaluation is matching the evaluation design to the program's marketing design. A program's marketing design consists of four elements: the product or service offered, its price, its promotion, and the delivery of products or services to the consumers. These four elements in the conservation program marketing design are discussed briefly before studying the evaluation options for each element. It was found that an evaluation of the program's marketing design provides not only an assessment of the program's current status but also guidelines for making the program more effective by identifying factors that must be better focused on the program's goals. 4 references, 1 figure.

8251 **(DOE/CE/24442—T1) Voluntary energy rating systems for residences. Final report.** (National Inst. of Building Sciences, Washington, DC (USA)). 15 Apr 1985. Contract FC01-84CE24442. 55p. National Institute of Building Sciences, Publications Department, 1015 Fifteenth Street, N.W., Suite 700, Washington, DC 20005. File Number TI87002214.

Consideration of residential energy efficiency at the time a home sells may permit adjustments in the loan qualification formula and, perhaps, allow more potential homebuyers to qualify for a mortgage loan. Although energy-efficient homes often carry a higher price tag, the savings that may result from lower fuel bills can be applied to monthly mortgage payments. This recognition of home energy efficiency can have a profound impact on home purchases during times of high interest rates and tight money supply. The NIBS project committee set out to define a set of minimum criteria and determine if the various user groups would accept a common "minimum" for the design of rating systems. Questions such as "what is an energy efficient home" were asked repeatedly throughout the committee's work. Lengthy discussions revealed that home energy conservation is very much a localized problem, with varying techniques and circumstances, and it may not be possible to define a minimum set of criteria that may be applied nationally.

8252 **(NP—7750362) Energy 85.** (Statens Energiverk, Stockholm (Sweden)). 20 Nov 1984. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750362.

This paper presents the comments of the National Energy Administration concerning a report of the use of energy in houses. The report has been produced by the Swedish Council for Building Research.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 8231, 8233, 8244, 8258, 8300

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 8395

8253 **(NP—7750346-Pt.1) Changing to lead-free gasoline. Consequences for Sweden's energy policy.** (Statens Energiverk, Stockholm (Sweden)). 1984. 110p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750346.

The report is divided into the following six areas: - Choice of octane number and specification. - Octane and lead requirements of the Swedish car population. - Effects on raw material supplies for the Swedish oil refining idustry. - Consequences for storage and distribution. - Consequences of the introduction by the Federal Republic of Germany of stricter exhaust requirements in an earlier stage than Sweden. - Effects on valid programs for alternative fuels.

8254 **(NP—7750365) Distribution of electricity to heat pumps within regions for distribution of district heating and natural gas.** (Statens Energiverk, Stockholm (Sweden)). 1983. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750365.

The report reviews the obligation to a distributor to deliver electricity to heat pumps within regions for district heating and natural gas. The distributor has the obligation to deliver electricity to all heat pumps using exhaust air or other external energy sources.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 7916, 7932, 7933, 7935, 7936, 7944, 7955, 8232

8255 **(NP—7750348) Coal -84. Report of ongoing and planned coal use in Sweden.** (Statens Energiverk, Stockholm (Sweden)). 1984. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750348.

This report has been made by the National Energy Administration on comission by the Swedish Government. It gives a compilation of existing and planned coal fired plants. The total coal consumption in Sweden is accounted for, just as the coal consumption at each plant. Figures are also given for the consumption of different coal qualities. The competition situation between coal and domestic fuels is commented. The infrastructure for coal use is briefly described, that is port-, railway- and road facilities. An account like this will be compiled yearly by the National Energy Administration.

8256 **(NP—7750349) Coal -85. Report on ongoing and planned coal use in Sweden.** (Statens Energiverk, Stockholm (Sweden)). Aug 1985. 51p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750349.

This is the second report concerning coal utilization in Sweden. The total coal consumption is accounted for, just as the coal consumption at each coal fired plant. Figures are given for the consumption of different coal qualities. New coal fired plants taken into operation is described. The coal trade is described. The competition situation between domestic fuels and coal is discussed. The infrastructure for coal transportation is treated.

2960 Electric Power

REFER ALSO TO CITATION(S) 8152, 8217, 8231, 8242, 8254, 8267, 8303

8257 **(ESC-WR—85-29) Compensation arrangements for locally generated electric power in Zuid-Holland.** Kruijswijk, B.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Dec 1985. 157p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The electric utilities in the Dutch province Zuid-Holland, united in the N.V. EZH ('EZH, Inc.') have proposed compensation arrangements for electric power, produced by private individuals or companies and electric power distribution companies. The reasoning behind this concept is that local producers sometimes fall back on generating and transmission capacity of central producers. The local producers have to pay for these services. An arrangement for distribution companies has passed the board of directors of the N.V. EZH. The studies which lead to this point of view are described and discussed. Local authorities fear that arrangements of this kind will be prohibitive with respect to local initiatives for generating electric power. Recommendations of the Energy Study Center of the Netherlands Energy Research Foundation are given. 34 refs.

8258 **(ESC-WR—86-11) Composition of the electric power demand curve in The Netherlands.** Blok, K.; Turkenburg, W.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Rijksuniversiteit Utrecht (Netherlands)). Aug 1986. 26p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The parts of the electric power demand curve that can be attributed to the different industrial sectors, agriculture, transportation sector, commercial sector, buildings, public services, households, etc., are described. The constructed curve is compared with the realized one. It is indicated how the demand curve will be influenced when the different sectors will realize a growth as predicted by the Central Planning Bureau. Recommendations for more comprehensive studies are given. 4 figs., 6 tabs., 37 refs.

8259 **(NP—7750293) Regional energy supply 1984-1985. Report of activities of the Regional Cooperation of Electric Utilities (ARE).** (Arbeitsgemeinschaft Regionaler Energieversorgungs-Unternehmen (ARE) e.V., Hannover (Germany, F.R.)). Apr 1986. 227p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87750293.

An introductory preface dealing with the interaction of regional energy supply and economic development is followed by a survey of activities pursued by the Regional Cooperation of the Electric Utilities (Arbeitsgemeinschaft Regionaler Energieversorgungs-Unternehmen/ARE) since the 1984 annual meeting. The survey points out problems of energy policy, public supplies which are subject to exceptional cadastral regulations, legal aspects of energy economics and other topical problems of regional energy supply. The final chapter is dedicated to a description of the ARE and how it is organized.

8260 **(NP—7750345) Modelling of electric power systems. A description and comparison of ten models of electric power systems.** Karlsson, S. (Statens Energiverk, Stockholm (Sweden)). Nov 1984. 111p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750345.

This report describes and compares ten computer models which may be used for analysis of the Swedish electricity system. Eight of the models are technical models and represent the electricity production system with different categories of power plants. Six of these are pure production models and use a given electricity load curve. The other two are modelling more or less the whole energy system, not only different energy carriers but also different technologies for energy use. The last two models are general equilibrium models describing the whole economy of the society. Here the electricity system is just a small part of the production and consumption in the society. The technical models are compared with respect to their ability to represent different qualities of the electricity system. For the Swedish electricity system, where hydro power is a substantial part, it is very important to consider different constraints on the production possibilities to obtain correct results. The general equilibrium models are analyzed with respect to thin mechanisms for changing the electricity system over time. Finally the applicability of the ten models for analysis of different issues is discussed.

8261 **(NP—7750347) Electrical power losses. Measures to prevent and to reduce the effects of power losses during peace.** (Statens Energiverk, Stockholm (Sweden)). Jan 1986. 63p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750347.

The National Energy Administration has investigated the need of measures for prevention of electrical power losses. Four municipalities and their electricity distributors have been studied. Further have the conditions and needs of 70 municipalities and 135 electricity distributors been mapped through an inquiry.

8262 **(NP—7750364) National Electrical Inspectorate.** (Statens Energiverk, Stockholm (Sweden)). 1984. 36p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750364.

The report reviews the organization, resources and duties of the National Electrical Inspectorate (NEI). The report also presents other organizations of interest for NEI and dealing with security problems concerning the distribution of electricity. NEI is also responsible to keep actual maps showing the Swedish network of power transmission lines.

8263 **(NP—7750368) Statistics of fires caused by electric installations. Survey of the causal factors.** Troeng, H. (Statens Energiverk, Stockholm (Sweden)). 1984. 63p. (In Swedish). NTIS (US Sales Only), PC A04. File Number DE87750368.

The National Energy Administration is responsible for the issue of security regulations concerning electric installations. This paper reviews the fires caused by electric installations, in house properties and farm buildings during 1981 and 1982. Each fire reviewed caused property damage of more than 500,000 SEK.

8264 **(STEV-NYEL—86-3) Studies of electric power systems by means of the system model ELFIN. Calculation and analysis of power balance for the year 1995.** Karlsson, S. (Statens Energiverk, Stockholm (Sweden)). Oct 1985. 54p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750353.

Power balances for various water years and scenaries are presented and the costs vary very much, from 0.11 to 0.31 SEK per kWh and from 3700 MSEK to 8300 MSEK per wet or dry year. The marginal cost will follow the load. The calculations are compared with the power balance model KR 70. Recommendations concerning new applications are made.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 8063, 8106, 8114, 8116, 8126, 8146, 8233

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

8265 **Slagging coal combustors for MHD applications.** Bauer, M.; Braswell, R.; Iwata, H. (Applied Technology Div., TRW Space and Technology Group, Redondo Beach, CA). pp 656-661 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper presents an overview of the MHD slagging combustor development status at TRW including the 11 year total development process and the 8 1/2 years of development while under contract to the DOE. The general design features of the high pressure MHD slagging coal-fired combustor approach is presented together with the specific features of the 10,20 and 50 MW MHD two stage coal combustors. The results of each of the combustor development programs has been summarized and the specific slag recovery, heat loss and carbon conversion results are presented. At the 20 MW/sub t/ combustor level, the feasibility of operating the combustor at stage-of-the-art air preheat levels (900-1500°F) was investigated. These results are compared to the high air preheat (2900°F) tests conducted with the same 20 MW/sub t/ combustor. With the benefit of these test results, a low air preheat modification to the 50 MW/sub t/ combustor was designed with fabrication and testing scheduled to start in 1986. Both the 20 and 50 MW/sub t/ coal-fired combustors were tested as part of MHD topping cycle test power trains. The 20 MW/sub t/ combustor was tested with the VCO designed MK VI channel at the AVCO Everett MDH test facility located near Boston. The 50 MW/sub t/ combustor was tested at the DOE's Component Developemnt and Integration Facility (CDIF) in Butte, Montana with the AVCO 1A1 channel. Plasma conductivity and power results from both of these test programs are presented.

3003 Thermoelectric Generators

8266 **Commercial oxide paints as coatings for SiGe thermoelectric materials.** Amano, T.; Beaudry, B.J.; Gschneidner, K.A. Jr. (Ames Lab. and Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA 50011). pp 1394-1396 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract W-7405-ENG-82.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Silicon-germanium alloys are used as thermoelectric materials for radioisotope thermoelectric generators. One problem is the loss of the alloy by sublimation. In the Unicouple sublimation was minimed by a Si/sub 3/N/sub 4/ coating. In the multicouple design the application of Si/sub 3/N/sub 4/ coatings which is done at high temperature is not practical. Suppression of sublimation in the

Multicouple design is presently accomplished by applying glass coatings. The difficulties encountered with the glass coatings are associated with the poor adherence of the coatings. In the present study, commercial oxide paints (mainly ZrO/sub 2/) which have low thermal expansion coefficients are used as coating materials. No spalling from the surface of the coated sample occurred in 1506 hours at 1080°C in vacuum, and sublimation was reduced significantly. Zirconium silicate was observed on the surface by x-ray diffraction.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 8326

8267 **(PB—87-102174/XAB) 40-kW on-site fuel-cell field-test program. Final report, January 1982-May 1986.** Eklund, L.G. (International Fuel Cells Corp., South Windsor, CT (USA)). Jul 1986. 278p. (FCR—78264A). NTIS, PC A13/MF A01.

The report describes the manufacture, installation and testing of 40-kW fuel-cell power plants. 300,000 hours of operating experience were demonstrated by the end of the test program, with individual power plant operating experience exceeding 11,000 hours. Thirteen units operated for over 8000 hours. The power plant performed as predicted in a wide range of applications, environments, and duty cycles. High efficiency, low environmental intrusion, and rapid response were demonstrated repeatedly and consistently. Unique fuel-cell components demonstrated high integrity throughout the test. The program demonstrated the ability of personnel in utility, industrial, and military organizations to install, operate, and maintain on-site fuel-cell power plants.

8268 **(STEV-NYEL—86-2) Fuel cell plants in Sweden.** Sjunnesson, L. (Statens Energiverk, Stockholm (Sweden)). 2 Dec 1985. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750360.

The paper reports from a study of the research and development of fuel cells in USA and Japan. The paper also discusses the possibility to install fuel cells plants in Sweden. (K.A.E.).

8269 **Stress and fracture behavior of monolithic fuel cell tapes.** Majumdar, S.; Claar, T.; Flandermeyer, B. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). *Journal of the American Ceramic Society;* 69: No. 8, 628-633(Aug 1986).

This paper summarizes the stress and fracture analyses of a three-layer ceramic composite which is a fundamental building block for the monolithic solid oxide fuel cell currently being developed at Argonne National Laboratory. A small difference in the coefficients of thermal expansion of different layers can result in large stresses and cause cracking parallel to the plane of the layers. A simple fracture model for a three-layer composite has been developed. The cracking behavior predicted by the model is in reasonably good agreement with the fabrication experience to date.

8270 **Doe molten carbonate fuel cell program technology issues and plans.** Gmeindl, F.D.; Kolba, V.M. (Morgantown Energy Technology Center, U.S. Dept. of Energy). pp 1128-1132 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The United States Departament of Energy (DOE) has supported development of molten carbonate fuel cells (MCFC) for more than a decade. The ultimate objective of the DOE MCFC program is to provide MCFC technology for coal-fueled applications. However, early entry plants are expected to be small and methane-fueled. The technology has progressed from materials, component and cell development to fabrication and testing of subscale (20 cell x 1-ft/sup 2/) stacks. Satisfactory performance has been observed in a 5,000 hour (h) subscale stack test. Based on the goals for coal-fueled central station power plants and the subscale stack test results, additional development is required to improve endurance and reduce cost. The current principal technical problems are (1) cathode dissolution, (2) electrolyte management, (3) component compaction, (4) thermal cycles, (5) corrosion, and (6) contaminats. Issues presented by scale-up in area and height also must be identified and addressed. This paper describes each of the techical problems and their manifestation in subscale stack test results. Current approaches and DOE plans for new efforts to address these priority problems are stated. DOE plans for obtaining scale-up experience as well as identification of early entry stack development requirements and development of a full-size stack are discussed.

8271 **Application of fuel cells to chlorine-caustic technology.** Taylor, E.J.; Waterhouse, R.; Gelb, A. (Physical Sciences Inc., Andover, MA 01810). pp 1133-1138 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A novel system concept for producing concentrated sodium hydroxide at a chlor-alkali plant is described. This system consists of a coupled membrane brine electrolysis cell and membrane alkaline fuel cell reactor. A systems analysis has shown that the Physical Sciences Inc. (PSI) system has the potential for large energy savings for the chlor-alkali industry. The results of screening studies of various advanced cation exchange membranes in this environment are presented and discussed.

3008 Miscellaneous Converters

8272 **Pyroelectric conversion materials.** Olsen, R.B.; Bruno, D.A. (Chronos Research Labs., Inc., 3025 Via de Caballo, Olivenhain, CA 92024). pp 89-93 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Copolymers of vinylidene fluoride, trifluoroethylene P(VDF-TrFe), exhibit large piezoelectric and pyroelectric effects. Pyroelectric conversion is a new application of the pyroelectric effect in which heat is converted directly into electrical energy. This study reports measurements of pyroelectric energy conversion cycles of P(VDF-TrFE) for a specific monomer ratio (60% VDF). The lower temperature of thermal cycles was fixed at 25C and the upper temperature was varied between 100C and 120C. These cycles are the first ever measured in which the temperature excursions exceeded the Curie point (hence yielding high energy densities). Conversion cycles with greater than 900 KJ/m3 were measured. These conversion cycles had electric energy densities over seven times larger than previously measured for this (or any other) polymer.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

8273 **(ESC-WR—86-14) Data of energy processes used for developing Dutch energy scenarios. Part A: Explanation. Part B: Tables with data and processes.** Van Arkel, W.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1986. 59p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Data are given with respect to technical, economical and environmental aspects of energy processes. The environmental aspects deal with emission and abatement of sulfur dioxide, nitrogen oxides and particulates. The processes are arranged in sectors: production of fuels, petroleum refineries, electric utilities, public heat generation, industrial energy consumption, households, agriculture, transportation systems and a rest sector. The data are put together to form the ESC (Energy Study Centre of the Netherlands Energy Research Foundation ECN) Data Base. 40 tabs.

3201 Buildings

REFER ALSO TO CITATION(S) 8077, 8084, 8087, 8250

8274 (CONF-860641—, pp 212-217) **Accelerated ageing of low emissive coatings.** Alexis, J.; Georgson, M.; Harris, S.; Ribbing, C.-G.; Roos, A. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

The optical effects of heat treatment in air and vacuum, condensation of water and acids as well as climate exposure on noble metal based multilayer window coatings are reported. It is concluded that below 200 deg C, diffusion is the dominant degradation mechanism, while oxidation is more prominent above that temperature. The diffusion is verified by Auger spectroscopy depth profiles.

8275 (CONF-860641—, pp 218-223) **Snow-melting and snowloads on glass roofs.** Nielsen, A. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

The use of glazed roof at high latitudes has its own special problems. One of these is the snowload on the roof. The snowload can be reduced because the snow will begin to melt if the accumulation is above a certain thickness. This thickness can be calculated dependent on the indoor temperature, outdoor temperature, thermal conductivity of the snow and the U-value of the glazing. In the figures is found calculations on different cases. The thickness of the snow and melting is given in a table. Finally is found a recommendation for dimensioning of a roof above a heated glazed space.

8276 (CONF-860641—, pp 303-308) **Coupling of heat and electricity production in renewable energy systems.** Gabler, H.; Luther, J.; Nolte, M. 1986. NTIS (US Sales Only), PC A14/MF A01. File Number DE87770021.

From North Sun '86 - international conference; Copenhagen, Denmark (10 Jun 1986).

Solar heating systems generally include a back-up device powered by conventional energy. The nonrenewable energy demand is significantly reduced if systems are considered where both heat and electricity are supplied on the basis of renewable sources; in this case energy that is of no use to the electrical supply (surplus electricity due to the finite storage capacity and waste heat from auxiliary energy production) can be transferred to the heating system thus reducing nonrenewable energy input. Simulation calculations were carried out concerning a coupled system that had been optimized with respect to energy pay back time. System components are: solar collectors, heat storage, heat pump, photovoltaic array, wind energy converter, electrochemical storage and a fossil fuelled motorgenerator.

8277 (CONF-861181—2) **Cooling energy measurements of houses with attics containing radiant barriers.** Levins, W.P.; Karnitz, M.A.; Knight, D.K. (Oak Ridge National Lab., TN (USA); Tennessee Valley Authority, Chattanooga (USA)). 1986. Contract AC05-84OR21400. 12p. NTIS, PC A02. File Number DE87001677.

From 3. annual conference on improving building energy efficiency in hot and humid climates; Arlington, TX, USA (17 Nov 1986).

Tests were conducted by Oak Ridge National Laboratory (ORNL) to determine the magnitude of the energy savings brought about by installing radiant barriers in the attics of single-family houses. The radiant barrier used for this test was a product with two reflective aluminum surfaces on a kraft paper base. The radiant barrier has the potential to reduce the radiant heat transfer component impinging on the fiberglass attic insulation. Working as a system in conjunction with an air space, the radiant barrier could theoretically block up to 95% of far-infrared radiation heat transfer. The results showed a savings in the cooling loads of 21% when the radiant barrier was laid on top of the attic fiberglass insulation and 13% with the radiant barrier attached to the underside of the roof trusses. The savings in electrical consumption was 17% and 9%, respectively.

8278 (CONF-861211—17) **Heat pump ground coil analysis with thermal interference.** Mei, V.C. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02. File Number DE87002621.

From American Society of Mechanical Engineers winter meeting; Anaheim, CA, USA (7 Dec 1986).

When two horizontal ground coils are buried in the same trench, one on top of the other, the total energy exchange coils and ground increases drastically over that of a single coil for the same trench length. However, due to the thermal interference between the two coils, the overall performance of the the two-coil trench is very difficult to determine. Traditionally this type of problem is handled by the line source mirror image approach. But this approach, due to the requirement of estimating the strength of the source, will result in extremely conservative ground coil design. This paper provides a detailed mathematical model to describe the operation of the two-coil system which can calculate more realistically the performance of the ground coils, which in turn could make the ground coil heat pump system more economically competitive with other heating and cooling systems. The effect of thermal interference is clearly shown in the calculated soil temperature profile. The effect of fluid inlet positions, from upper or lower coils, is also studied. The comparison of measured and calculated daily energy absorbed from the ground indicated a maximum error of 27%, with the average error at less that 16%, with the calculated values on the conservative side. This model can better calculate the performance of two coils in the same trench.

8279 (CONF-870101—2) **Procedure for determining the optimum foundation insulation levels for new, low-rise residential buildings.** Christian, J.E.; Strzepek, W.R. (Oak Ridge National Lab., TN (USA); Dow Chemical U.S.A., Granville, OH). 1986. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87000399.

From American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting; New York, NY, USA (18 Jan 1987).

This paper documents a procedure which can be used to determine the optimum foundation insulation levels for new, low-rise residential buildings. This procedure has been used to develop the recommended foundation insulation levels for ASHRAE Standard 90.2P, entitled Energy Efficient Design of New, Low-Rise Residential Buildings. Basements, crawlspaces and slab-on-grade construction are addressed, as well as floors above unheated spaces. The assumptions on which this study is based, such as the economic parameters and the energy load calculation model are discussed, and optimum foundation insulation levels are included for all locations in the US. One of the major findings of this analysis is that at least some insulation is cost effective for all the foundation types in most climates. This is not consistent with predominate building construction practices. Foundation insulation recommendations included in previous ASHRAE standards for new residential construction were not based on the same criteria as the recommendations for the above grade envelope components. The systematic procedure described in this paper can be used to determine foundation insulation levels that are consistent with above grade conservation measures on an economic basis.

8280 (DOE/BP—676) **Builders Exit Survey report for the Residential Standards Demonstration Program.** Johnson, M.E. (USDOE Bonneville Power Administration, Portland, OR. Office of Conservation). Jun 1986. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002664.

This report analyzes and summarizes the results of a Builders Exit Survey conducted toward the end of the Residential Standards Demonstration Program. The purpose of this survey was to learn more about the builders themselves, their past practices, problems that they might have had in constructing MCS homes, and how they felt about the program. The group of builders represented here participated in the RSDP, and as such were a self-selected group. Consequently, the results of this survey are not generalizable to other builders in the Pacific Northwest. Over half the respondents (51%) were Washington builders, which is appropriate as, during the period of the RSDP, more than half of the new homes built in the region were built in the state of Washington. However, others have argued that the high percentage of Washington builders

tends to skew the survey responses toward the Washington response.

8281 **(DOE/CE/23858—2) Technology for efficiency measurement of woodburning and other solid fuel appliances: Phase 2, Progress report, September 26, 1983-August 31, 1986.** Jaasma, D.R.; Shelton, J.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Shelton Energy Research, Santa Fe, NM (USA)). Sep 1986. Contract AS05-83CE23858. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002442.

The purpose of the project is to determine the accuracy of several stack-loss efficiency measurement methods for solid fuel heaters. The methods include the Oregon method which has the force of law in Oregon, the WHA method developed under DOE sponsorship at Auburn University, the ASTM method (a more sophisticated version of the WHA method), and two "direct loss" methods. The direct loss methods are different from the other three methods in that chemical energy losses are determined by relatively direct measurements. During Phase II, stack-loss methods and room calorimetry (used as the "reference" method) were simultaneously used to measure the efficiencies of seven types of heaters. Preliminary findings on the accuracy of the stack-loss methods are given in this progress report.

8282 **(ECRC/M—2065) Domestic ventilation heat recovery using heat pumps.** McIntyre, D.A. (Electricity Council Research Centre, Capenhurst (UK)). Sep 1986. 38p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK.

The application of heat pumps to ventilation heat recovery in domestic houses is considered. It is shown that the most effective system is a combination of heat pump and heat recovery unit; a plate heat exchanger is the type commonly used. Such units are now commercially available, and can provide heat at a lower cost per kilowatt hour than the Economy 7 tariff. The performance of several units is presented, and seasonal running costs have been computed for a house equivalent to the Capenhurst low energy house design. A heat pump VHR unit would be incorporated in a full house ventilation system, and could provide up to half of the heat required on a design day. It would be practical to reduce or eliminate the storage heating capacity in the house, and use direct acting heaters to provide flexible, accurate temperature control. Such a heating system would provide good temperature distribution and low running costs. The application of a heat pump VHR unit would therefore seem to be an attractive option in a low energy house. Development work is needed on the details of installation and control.

8283 **(NP—7750300) Heat supply to large buildings by energy-saving heat pump systems with the example of a block of flats at Hildesheim, Salzwiese 30A.** Ammann, G.; Panschow, R. (Hannover Univ. (Germany, F.R.)). 20 Feb 1985. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750300.

The heat supply data of a four storey eight flat block were continuously collected and recorded by automatic metering, where the block was supplied with heating energy by groundwater/water heat pumps. Data are given on the position and type of building, the heating system and the heat resistance. The assessment of the measured data is done according to time periods, energy consumption (day/night tariff), outside on groundwater temperature, heating energy, heat resistance, inside temperature, control characteristics, heating output, work figure and house energy (15 minute maximum). By using the groundwater heat pump and underfloor storage heating, the annual costs could be reduced to 7 DM/m^2. Oil heating would use 40% more primary energy. There were no feedback effects on the groundwater temperature. (HWJ).

8284 **(ORNL/Sub—85-27497/1) Assessment of the energy savings potential of building foundations research: Summary report.** Sterling, R.; Meixel, G.; Shen, L.; Labs, K.; Bligh, T. (Minnesota Univ., Minneapolis (USA). Underground Space Center; Undercurrent Design Research, New Haven, CT (USA); Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1986. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002968.

The major objective of this assessment is to answer three questions: (1) what is the energy savings potential of additional research on building foundations; (2) what useful research products are available in the area of foundation thermal performance; and (3) what research opportunities exist that could lead building practitioners to specify energy-efficient foundation systems as an integral part of buildings?

8285 **(PB—86-243730/XAB) Commercial-appliance energy-use update. Topical report, January 1984-January 1985.** Hurley, J.R.; Shukla, K.C.; Grimanis, M.P. (Thermo Electron Corp., Waltham, MA (USA)). May 1986. 136p. (TE—4342-15-86). NTIS, PC A07/MF A01.

The purpose of the report is to provide updated information on energy consumption, inventory, and annual shipments of equipment found in the commercial sector. The information is broken down by functional use and fuel (gas, oil, electricity) for 1982. The results of a survey on appliances using energy efficiency and technology are also included.

8286 **(PNL—5966) Cutting energy costs in multifamily housing: Practical case studies for the builder and developer.** Whiddon, W.I. (Whiddon (William I.) and Associates, Inc., McLean, VA (USA)). 1986. Contract AC06-76RL01830. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87002469.

This book is based on an expert evaluation of nine existing and three proposed multifamily housing projects across the US. The existing buildings include three lowrise projects (three to four stories), six midrises (five to seven stories), and three highrise buildings (nine to thirty-nine stories). Two projects were designed and built in the late 1950's, two in the late 1960's, and five late in the "energy-crisis" of the 1970's. The existing projects range from municipally subsidized elderly housing, to HUD Section-8 suburban developments, to luxury urban highrise buildings. The three "future" buildings, designed by the NAHB research team, were based on trends anticipated in the multifamily industry by IREM and NAHB leaders, over the next five years. The key trends identified were: downsizing of units (by 10 to 20%); increased project size (in number of units), denser developments (more midrise and highrise projects), and increased amenities - all in the context of more affordable housing.

8287 **Thermal analysis of buildings: configuration perturbations and observed climate interface.** Sullivan, R.; Huang, Y.J.; Bull, J.C.; Turiel, I.; Ritschard, R.L.; Selkowitz, S.E. (Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **92**: No. 1A, 137-151(1986). (CONF-860106—). Contract AC03-76SF00098.

From ASHRAE semi-annual meeting; San Francisco, CA, USA (19 Jan 1986).

Results are presented that indicate a proportional relationship between residential building thermal loads for varying configuration parameters. Through the use of numerous building energy simulations using both the DOE-2.1 and BLAST energy analysis computer programs, it is shown that the form of the relationship is independent of climatic location and covers a broad spectrum of those variables that influence a building's energy use. A simplified theoretical justification associated with such a phenomenon is presented using a multiple regression-derived algebraic expression that clearly establishes the linear independence of a building's heat gain/loss components. Procedures are defined for the simplification of future parametric studies of the thermal analysis of buildings using a methodology that incorporates the observations reported herein.

8288 **The effect of short cycling and fan delay on the efficiency of a modified residential heat pump.** Mulroy, W.J. (Building Equipment Div. of the Center for Building Technology at the National Bureau of Standards, Gaithersburg, MD). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **92**: No. 1B, 813-826(1986). (CONF-860106—).

From ASHRAE semi-annual meeting; San Francisco, CA, USA (19 Jan 1986).

The object of this study was to determine if the use of a cycling controller would improve the efficiency of a residential air conditioner or heat pump. Cyclic tests were performed on a capillary tube heat pump in three configurations: as manufactured, as modified to simulate a non-bleed expansion valve unit by operation of a valve in the liquid line, and as modified to simulate an air conditioner by elimination of the accumulator. The two modifications, the liquid valve installation and accumulator removal, were found to greatly improve the cyclic performance to about equal levels; however, some cyclic losses remained. It was concluded that any control strategy that resulted in shortened on-cycle run times would reduce cyclic efficiency for all designs tested. It was further concluded, based in part on the work of others, that fan delay is an undesirable control strategy for units that have the indoor air handler and coil installed within the conditioned space.

8289 **Indirect evaporative cooler system optimization.** Turner, R.H.; Chen, F. (Dept. of Mechanical Engineering, Univ. of Nevada-Reno 89557). pp 1226-1229 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Although it is recognized that a two-stage (Indirect) evaporative cooler (EC) can deliver colder supply air than a single-stage (Direct) EC, few guidelines exist to decribe how large each component in the two-stage system should be to optimize performance based on minimum cost. The present paper considers the cost function of an ID/D EC and establishes necesary constraints to performance. The cost function is then minimized consistent with the constraints to help develop guidelines necessary to systems optimization. A sample calculation indicates the technique.

8290 **Dual temperature thermal storage with complex compounds.** Rockenfeller, U.; Martin, J.F. (Rocky Research Corp., Boulder City, NV). pp 755-759 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Storage of thermal energy through the formation or dissociation of complex compounds is described. A solid-vapor reaction of an absorbant, a metal inorganic salt, and an absorbate, the ligand of the complex provides energy storage for a heat pump cycle. One system is capable of dual temperature storage, that is storage of cool for air conditioning and storage of heat for heating. Laboratory experiments which define the material and reaction characteristics of a sodium bromide/ammonia system were performed. The reaction rates, storage density and other operating parameters are described in functional form. The performance of a heat pump storage system is projected from these experimentally determined properties. The resulting system compares favorably with existing cool storage systems and with proposed heat or cool storage systems.

8291 **Building thermal monitoring methods.** Burch, J.D. (Solar Energy Research Institute, 1617 Cole Boulevard Golden, CO 80401). *Passive Solar Journal;* **3**: No. 2, 149-178(1986).

Any method for monitoring building thermal energy has three key steps: model selection, building testing, and model analyses. first a thermal model of the building must be chosen that accounts for all major thermal processes and that adequately answers the questions motivating the monitoring project. Once a model is chosen, a test is designed and executed to determine from data the unknown descriptive model inputs for the building at hand. Tests are either short term (days or weeks) or long term months or seasons). Lastly, analyses are performed using the model with its measured inputs to provide the desired answers. The calculations made as part of these analyses often involve procedures for normalizing occupancy and weather and for choosing a reference building. As a general rule, model and test data should be matched on time and space levels. Only several of the many possible combinations of modeling and testing techniques are widely useful. Examples of matching and mismatching model and data are given.

8292 **Measured results of energy conservation retrofits in residential buildings.** Goldman, C.A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **92**: No. 1A, 152-163(1982). (CONF-860106—). Contract AC03-76SF00098.

From ASHRAE semi-annual meeting; San Francisco, CA, USA (19 Jan 1986).

This study summarizes measured data on energy savings from conservation retrofits in existing residential buildings. Retrofits to the building shell, principally insulation of exterior surfaces, window treatments, and infiltration-reduction measures, are the most popular, although data on various heating system retrofits are now available. The average retrofit investment per unit in multifamily buildings is approximately $700, far lower than the average of $1350 spent in single-family residences. Savings achieved are typically 20% to 30% of pre-retrofit space heating energy use, although large variations are observed both in energy savings and in costs per unit of energy saved. Particularly cost-effective retrofit strategies are identified based on measured energy use data. Predicted versus actual savings are also compared for groups of homes in 24 retrofit projects.

3202 Transportation

REFER ALSO TO CITATION(S) 8782

8293 (KFK-PEF—4-Vol.3, pp 895-908) **Determination of representative motor-maps for cars.** Axhausen, K.; Benz, T. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The project tries to provide representative motor-maps for the microscopic simulation of traffic-flow. This data-base would allow a more detailed analysis of the effects of traffic system-management on emissions and energy-consumption. The main part of the paper explains the preparations for collecting the motor-maps and the regression approach which will be used for the data collection. The last part of the paper presents briefly the analysis of the development of the car-market in the Federal Republic of Germany.

8294 **(STEV-TORV—86-16) Transport systems - solid indigenous fuels.** Colliander, J. (Statens Energiverk, Stockholm (Sweden)). Dec 1985. 302p. (In Swedish). NTIS (US Sales Only), PC A14/MF A01. File Number DE87750354.

The following problems have been indentified: - A rational structure of transporting requires an established and relatively open market. - The necessary rolling stock for fuel conveyance by rail is not available. - Roads have to be improved and new roads have to be built. Railways with low load now might get a motivation for reinforcement. - Because of the irregular spread of consumption storing and terminals problems will arise and increase the cost of transport. - Terminals and stores are situated at a convenient place for one single enterprice. On a far-away aim this will not be rational.

8295 **Rotating Bubble Membrane Radiator for space applications.** Webb, B.J.; Antoniak, Z.I. (Pacific Northwest Lab., Richland, WA 99352). pp 1881-1885 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—). Contract AC06-76RL01830.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

An advanced radiator concept for heat rejection in space is described which uses a two-phase working fluid to radiate waste heat. The development of new advanced materials and the large surface area per mass makes the Bubble Membrane Radiator an attractive alternative to both conventional heat pipes and liquid droplet radiators for mid-to high-temperature applications. A system de-

scription, a discussion of design requirements, and a mass comparison with heat pipes and liquid droplet radiators is provided.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 7912, 8221, 8285

8296 (BMFT-FB-T—86-049) Planning, projection and construction of a pilot farm in Liebenau with test operation of demonstration plants and scientific measuring. Final report. Lorre, R.; Marx, G.; Suttor, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1986. 261p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750292.

During this research project, the projected demonstration plants of the projects 03E-5319-C-A+E for the pilot farm of Liebenau have been realized and their operation has been evaluated over a period of two years. Three systems of biogas facilities have been tested with different operating times and different temperatures of liquid manure. The fertilizing value of the digested liquid manure has been determined. A heating station operated with biogas, natural gas or diesel fuel supplies current and heat. Its efficiency with the different fuels has been determined. A combined incinerator for straw and wood has been tested in practical operation. From the waste heat of a piggery, useful heat has been obtained by means of an electric heat pump. The efficiency of the heat pump could be improved during the test period. New energy-saving techniques have been tested in glasshouse cultivations. A test with a tractor operated with rape seed oil/diesel oil mixtures, resp. pure rape seed oil, could be performed with technical success. New processes in green forage harvesting and evaluation have been tested. Five different systems of soil cultivation have been compared with each other. With 21 refs., 62 tabs., 41 figs.

8297 (DOE/CE/40626—T2) Research on droplet formation for application to kraft black liquors: Technical report No. 2. Stockel, I.H. (Maine Univ., Orono (USA)). Oct 1986. Contract AC02-83CE40626. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003169.

The Department of Energy and the American Paper Institute joined in supporting research at the Chemical Engineering Department of the University of Maine at Orono to develop a fundamental understanding of the liquid droplet formation process with particular emphasis on kraft black liquors. The five year program is divided into five tasks. Work began on October 1, 1983. Tasks I and II have seen significant progress and are the primary topics of this report: droplet formation from single jet, and measurement of surface tension. The overall objective of this program is to develop a fundamental understanding of the droplet formation process at conditions relevant to the processing of kraft black liquors. Goal is to develop new knowledge which can result in the design of better spray nozzles for more energy efficient and productive operation of kraft recovery boilers.

8298 (DOE/CS/40005—T6) Brayton-cycle solvent recovery system development test results: Topical report: Phase 3, System test 86-30013: Rev. 1. (AiResearch Mfg. Co., Los Angeles, CA (USA)). 30 Sep 1986. Contract AC07-78CS40005. 170p. NTIS, PC A08. File Number DE87002828.

This report presents the component fabrication, system assembly, performance testing, and also an updated economic analysis of the marketability of future systems. The Brayton-cycle system was designed to recover the solvents evaporated in a 3M Company magnetic tape production facility. The major solvents utilized are MEK and toluene. The system was designed to receive the warm solvent/air mixture from the drying oven, remove the solvents by condensation, and return the warm air to the oven in a recirculating system.

8299 (ECRC/M—1909) Energy measurements for melting cast iron using dried or preheated charge in mains frequency coreless furnaces. Bullard, H.W. (Electricity Council Research Centre, Capenhurst (UK)). Mar 1985. 4p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Memorandum.

Energy measurements are given for three iron foundries which use mains frequency coreless furnaces and dry or preheat the charge material. The results demonstrate that a reduction in the electrical energy consumption in the coreless furnace can be made provided preheating is undertaken rather than drying alone.

8300 (ESC—35) Large-scale energy production in industry. Possibilities for steam production in the period 1990-2000. Sensitivity of the cost-effectiveness. Van Wees, F.G.; Koenders, N.J.; Doorenspleet, H.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1986. 256p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A model for economic analysis of co-generation is described. Calculations have been made for the economics of co-generation in the Netherlands for the 1990's. Five levels of steam demand (17,30,55,106 and 212 t/hr) and three types of units (gasturbine with waste-heat boiler, STAG and gas- or coal (AFBC) high pressure steam boiler with backpressure turbine) have been considered. Distinction has been made between two forms of management: by industry or by public utilities. A sensitivity analysis has been carried out with respect to fuel prices, prices of electricity, delivery (25%) to the public grid, load factor and investment costs. The report includes a data-base on the parameter values used.

8301 (ESC-WR—86-12) Manure: spreading, processing or preventing. Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1986. 26p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In The Netherlands there is a large surplus of pig manure. This surplus is concentrated in ecologically sensitive areas from which it must be removed. Truck transport is expensive and unattractive, so that dumping of the manure on the land is the practical result. Different solutions for surplus pig manure treatment are described. Energy consumption and environmental aspects are quantified and techniques of social cost-benefit-analysis are explored. The best solution is to avoid high density pig farming and promote the establishment of new pig farms in areas where the manure can be used locally as fertiliser. Second best is to build a complex infrastucture consisting of pipelines, biogas production and eventual ship transport of the digested manure. Within this infrastructure, further processing (e.g. thickening, ammonia-stripping, membrane separation, combustion) could be combined to obtain concentrated fertiliser products. 3 figs., 3 tabs., 12 refs.

8302 (IVO-A—02/85) Possibilities of high-frequency technique in paper industry. Soininen, M.; Salmela, J.; Kara, M.; Peraeniitty, M. (Imatran Voima Oy, Helsinki (Finland)). Nov 1985. 62p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750389.

This report deals with dielectric drying of fibrelike bands. In this technique the material is heated simultaneously in all depths. Dielectric method is good for moisture smoothing, because then no regulation across the band is needed. For drying of paper and especially cardboard stray-field electrodes and waveguides are most suitable. Whereas for surface gluing and drying of coating waveguides are probably most suitable. Dielectric method can also be applied for drying of veneer and pasteboard and to lower the viscosity of water in bands before pressing. Within the next few years application of thyristors and transistors will increase the efficiency factor of the equipment and lower their prices.

8303 (NP—7750344) Industrial back pressure. Production Potential Prognosis. (Statens Energiverk, Stockholm (Sweden)). Nov 1984. 147p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750344.

830 MW of the existing back pressure power is produced by pulp paper industry, the rest of the industry producing 100 MW. The yearly electrical power production is about 2.5 TW per year. The theoretical potential for the year 1990 is judged to be 5 TW per year. The total power production by back pressure is difficult to forecast. It might be 2.5 TWh per year when using solid fuels. New investments based on fuel oils will not be realized. Plants for

75 MW have ceased to exist or are planned to do so. Further 75 MW are in the risk zone. Discussions are on the way to consider the recommendations to keeping back pressure plants running. New technique for small plants is to be introduced and some 15 MSEK are granted for the period 1984/85 to 1986/87. (G.B.).

8304 **(NP—7750369) Flue gas condensation.** (Statens Energiverk, Stockholm (Sweden)). 20 Nov 1985. 21p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750369.

The flue gas condensation technique is reviewed, with its possibilities and applications. Operational experiences and research and development in progress are discussed. Finally, suggestions are given for future R and D areas. (L.E.).

8305 **(NP—7750384) Computer control for the Tampella double-grate boiler.** Imelaeinen, K.; Petaenen, P.; Koskela, O.; Sutinen, R. (Advanced Forest Automation Oy, Oulu (Finland)). 1986. 73p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750384.

Most of the new boilers recently installed in Finland are multifuel boilers using woodwastes and peat as the main fuel. Although burning of woodwastes and peat is economically most attractive, noticeable difficulties are encountered in the combustion control due to such fuel characteristics as varying physical properties, moisture value etc. In this project a control strategy was developed for the Tampella double-grate boiler. Special attention was paid to the grate burning properties and the function of the mechanical grate. The control system consists of the optimization of the Tampella multifuel boiler (K10) and the steam levelling control system of the power plant. Because of the rapid load fluctuations caused by boarding machine web breaks or fluctuations in digester house steam demand, a steam network levelling system was installed in the power plant. The main object of the project was to minimize oil burning in the K10-boiler and the whole power plant and the optimization of grate burning. The practical results of the mechanical grate function control and air distribution optimization are very encouraging. During normal operation boiler pressure and excess oxygen are very stable compared with other grate boilers. The response time of boiler load changes is also very fast compared to other boilers of this type. The main object of the whole boiler installation project was to decrease oil consumption by effective burning of domestic fuels. This object was attained better than was predicted.

8306 **(NP—7750386) Utilization of heat pumps in the dairy industry.** Koskela, O. (Valio, Helsinki (Finland)). 1986. 83p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750386.

Utilization of heat pumps in dairy industry has been studied in this work. Theories of heat pump technology it self has not been studied but the main purpose has been to apply this known technique in dairy industry. It has been found out that the traditional application of heat pumps, in which only the produced energy would be primary energy, would not be an economic investment. The main reason for this was the low price of heavy fuel oil and on the other hand the higher price of electric power. Two pilot plants using heat pumps of less than 1 MW were built up during this study. One of these plants was using ammonia gas and the other one was using ice water out of the process as the heat source. Both of the pilot plants have been found economically profitable.

8307 **(NP—7750387) Expert systems in process automation.** Arola, J.; Leiviskae, K.; Uronen, P. (Oulu Univ. (Finland). Dept. of Process Engineering). 1985. 44p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750387.

The report gives a survey on some prominent applications of Expert Systems in process control in fault diagnosis and alarm analysis. Some control applications are also surveyed. In the pulp and paper industry following potential fields of applications can be found. The analysis of alarms in common process monitoring, The information and measurements that are connected to preventive maintenance systems can be analyzed by an Expert System, Expert Systems can be used in controller tuning. The use of information from Digital Image Processing-system in actual process control may require on Expert System - like approach. Production scheduling and planning in mill wide applications (pulp mill and power plant) is done using simulation and computerized decision making (heuristics). Quality control, analysis of quality data and errors in quality and Emission monitoring and analysis of emission sources resemble the alarm analysis and therefore can utilize Expert Systems-approach. Same agrees with balance checking and measurement accuracy analysis. Especially the following processes can favour the Expert Systems: paper machine (quality), digesting (quality, grade/species changes), bleach plant (quality, measurement checking), recovery furnace and power boilers (safety, emissions, efficiency) and lime kiln (efficiency, measurement checking).

8308 **(NP—7750388) Energy economy of the steam and condensate systems of paper machines.** Maijala, A.; Karlsson, M.; Ulvas, M.; Toukonen, J. (Insinoeoeritoimisto Air-Ix Oy, Tampere (Finland)). 1986. 75p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750388.

Paper drying is consuming energy more than any other part of the paper producing process. The energy needed in the drying process is transferred mainly through the steam and condensate system. In this paper five different paper machines were studied. Very extensive process measurements were made for all the machines in different production situations and different paper grades. Based on the measurements calculations and recommendations were made for the actions. The recommendations concerned all the factors affecting to the economy, runnability, capacity and energy consumption. The studies showed clearly that the economy of the steam and condensate system is unambiguously represented by the steam flow to the condenser. Simple standard solutions to reduce the steam flow to the condenser cannot be recommended. In all cases the other parts of the system's operation has to be checked. The actions recommended in the reports made of all measured machines were completed for three machines already during this study. The achieved and measured energy savings were app. 3 Mmk/a and the investments were appr. 1.4 Mmk. The production capacity of one machine was increased appr. 10-15%.

8309 **(NP—7750394) New control systems for improving the quality control and energy efficiency of mechanical pulp process.** Laehteenmaeki, J.; Pietinen, P.; Rajala, M. (Tampere Univ. of Technology (Finland). Control Engineering). Feb 1986. 137p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750394.

It is widely known that pulp quality indicators are difficult to measure by on-line sensors. In this research special effort was devoted to investigating the disturbances which cause measurement errors in on-line drainage meters. The matter was studied theoretically as well as in practice. Estimators have been developed with which the influence of the worst disturbances was compensated. In this manner it was possible to increase the adaptability of on-line drainage meters in freeness control systems. The integrated control of a grinder room has been improved by using the experience gained from the AGMO (Automatic Groundwood Mill Operator) - system. It has been shown that the mathematical models predicting the operation of grinders can be simplified which in turn makes their on-line identification easier. The algorithm for computing the setpoint of the grinders has successfully been modified into a form which demands fairly small computer capacity. The freeness of the compound pulp produced by the stone group can be kept constant and simultaneously the production rate can be changed in a fairly wide range. The factors which affect the production rate of a grinder room and the specific energy consumption during a long period of time (such as freeness limits of one grinder and sharpening) were investigated by simulation. The simulation study indicated that better control of stone sharpness would raise the production capacity of a grinder room by 10-40% without degrading the pulp quality. The results of the project indicate clearly that by developing the automation of mechanical pulping processes the pulp quality variation can essentially the reduced and specific energy consumption can be decreased. To successfully use the results however the characteristics of the particular plant must be taken into account in planning and implementation. The grinder room control system developed in this project is ready to be utilized more widely.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 8091, 8257

8310 (ECRC/M—2054) Design of an aerobic thermophilic sludge digestion system. Morgan, S.F.; Winstanley, R.; Littlewood, M.H.; Gunson, H.G. (Electricity Council Research Centre, Capenhurst (UK)). Jun 1986. 10p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK.

For many years the Electricity Council Research Centre has been developing a viable aerobic themophilic sludge digestion system which would make use of the positive attributes of the VO2 Aeration System to economically transfer oxygen from air while conserving the biochemically derived heat energy in the sludge. Cooperation with the Welsh Water Authority began in 1975. Development has progressed from pilot projects to a full-scale retrofitted installation. A new system has been developed by adopting a more systematic design engineering approach and which offers several potential benefits: the sludge is rendered stable and inoffensive, the sludge is substantially pathogen-free, the volume of sludge is reduced, the system has low capital cost and the process has an acceptable energy cost and the process offers future opportunities for the export of heat energy.

8311 (NP—7750370) Interconnecting district heating networks. (Statens Energiverk, Stockholm (Sweden)). 19 Dec 1985. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750370.

The National Energy Administration has, on behalf of the Swedish Government, investigated the potential for interconnecting district heating networks in Sweden. The purpose is twofold: by creating a large heat load, cheap energy sources like waste heat can be employed more efficiently; a wider base for cogeneration installations can be established which is of special interest for the Swedish nuclear power phaseout. The 25 largest district heating plants in Sweden were asked about the possibilities for interconnections. The results of the survey are discussed in the report, as well as technical and institutional obstacles for an interconnection program. (L.E.).

8312 (NP—7750385) Energy requirements for rotating biological contactors in the sewage treatment plant of Lieksa City. Pouttu, P.; Korpela, J.; Saentti, R. (Ekono, Helsinki (Finland)). Jan 1986. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750385.

The energy requirement for the rotating biological contactors (RBC) and the other processes in the sewage treatment plant of Lieksa City have been studied in this report. The energy requirements for RBC-process were compared to energy requirements for activated sludge process. The biological process needs normally more energy than any other sewage treatment process. In addition to this biological process much energy is used for heating and ventilation of the plant. Instead of the most widely used biological process, the activated sludge process, municipalities have also used trickling filter- and RBC-processes. According to foreign studies an RBC-process designed for organic removal or nitrification has much smaller energy requirements than the activated sludge process. The measured energy use in the RBC-process in the sewage treatment plant of Lieksa City was 0.26 kWh per removed BOD_7 kg. The energy use in the two studied activated sludge plants designed for organic removal was 1.5 kWh and 1.6 kWh per removed BOD_7 kg and in two other plants designed for organic removal and nitrification energy use varied from 1.0 kWh to 3.6 kWh per removed BOD_7 kg. Operation of the RBC-process was observed to be much easier than operation of the activated sludge process. The BOD_7 amount treated in municipal sewage treatment plants in Finland was 114.500 tons in the year 1984. For example if 20% of that BOD_7 amount would be treated by means of RBC-process instead of activated sludge process, the savings in energy use would be 13.400 MWh/a, which is about 4 million FIM/a.

3209 Education And Public Relations

8313 (ESC-WR—86-02) Public reactions to large-scale energy technologies. Midden, C.J.; Daamen, D.D.; Verplanken, B. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Rijksuniversiteit Leiden (Netherlands)). Feb 1986. 21p. (CONF-861010—3). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 13. world energy conference; Cannes, France (5 Oct 1986).

In the first part of this article we discuss certain factors which are of influence upon the perception of risks connected to energy technologies. Several studies show that the catastrophic potential and the degree to which people consider negative consequences to be controllable are the main factors which influence this perception. In the next part differences between experts and lay people are discussed. Lay people are found to be bad at making numerical estimates of annual fatality frequencies of different causes of death. High frequencies appear to be underestimated and low frequencies overestimated. We conclude that differences between experts and lay people may be partly explained by the use of different concepts in talking about risks. In the third part attitudes on the use of nuclear energy and coal for the generation of electricity are discussed. Attitudes are determined by the observed probability of negative consequences rather than the expected probability of positive effects. It appears that the differences between the two groups are mostly not based on ideology but rather determined by a fairly rational trade-off of expected risks and advantages. The last part is concerned with the siting of nuclear power plants. The fact that people living near nuclear plants give a lower estimate of the risks than people living further away can be explained in a number of ways. Finally we discuss the problem of compensation for local residents and representatives in the choice of a site for a new plant. Our conclusion is that the usefulness of such strategies depends on the fact whether the perception of risks on a local level is based on feelings of insecurity or on an expert-like risk assessment. 4 figs., 35 refs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 7957

8314 (DOE/NASA—0168-10) Advanced Gas Turbine (AGT) technology project: 1985 annual report. (General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div.). 1 Sep 1986. Contract AI01-85CE50111. 158p. (NASA-CR—179484; EDR—12344). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002761.

AGT 100 activities during the past year were high-lighted by extensive engine testing, ceramic component fabrication and evaluation, component performance rig testing, and analytical studies. Although significant technical challenges remain, all areas experienced progress. Significant accomplishments accrued in the engine testing activity. Ten experimental assemblies (builds) were evaluated using the two engines. 1985 accumulated operating time was 120 hr of burning and 170 hr total. Total cumulative engine operating time to date is 395 hr.

8315 (N—86-26629) Preliminary evaluation of a compound cycle engine for shipboard gensets. Castor, J.G.; Wintucky, W.T. (Garrett Turbine Engine Co., Phoenix, AZ (USA)). Jun 1986. 29p. (NASA-CR—179451; DTNSRDC-PASD-CR—1886; GARRETT—21-5869). NTIS, PC A03/MF A01.

The results of a thermodynamic cycle (SFC) and weight analysis performed to establish engine configuration, size, weight and performance are reported. Baseline design configuration was a 2,000 hour MTBO Compound Cycle Engine (CCE) for a helicopter application. The CCE configuration was extrapolated out to a

10,000 MTBO for a shipboard genset application. The study showed that an advanced diesel engine design (CCE) could be substantially lighter and smaller (79% and 82% respectively) than todays contemporary genset diesel engine. Although the CCE was not optimized, it had about a 7% reduction in mission fuel consumption over today's genset diesels. The CCE is a turbocharged, power-compounded, high power density, low-compression ratio diesel engine. Major technology development areas are presented.

8316 **Adiabatic engine for improved combustion of powdered coal.** Kamo, R.; Kakwani, R. (Adiabatics, Inc., Columbus, IN 47201). pp 343-348 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The combustion characteristics of burning fine coal powder fuel in an adiabatic diesel engine were investigated. The results of 100% coal fueled engine are compared with standard diesel fuel-injected and dual fuel (Diesel+Coal) engines. Powdered coal of 5 micron average size was fumigated into the engine intake air manifold by a coal feed system. The engine was insulated with ceramic coatings which provided a reduction in the heat rejection rate. During the investigation, a new thermal ignition concept was uncovered for the adiabatic powdered coal fueled engine. The experimental results showed excellent combustion characteristics of the 100% coal fueled engine whose indicated thermal efficiency was found to be better than for the diesel fueled engine. Thermal ignition of the coal fueled engine was achieved in the high temperature engine without any external ignition aid such as a spark plug or glow plug. Unthrottled operation over a wide load range was also achieved. The results showed very fast burning with shorter combustion duration and high heat release rates for the coal fueled engine. The effects of engine speed on ignition and combustion of coal fuel are presented. Problems encountered during engine testing included piston ring wear and lubricating oil contamination with coal powder.

3302 External Combustion Engines

8317 **(CONF-860810—34) Measurements with the Reversing Flow Test Facility.** Roach, P.D. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 7p. NTIS, PC APC A02/MF A01; 1; GPO Dep. File Number DE87001515.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The Reversing Flow Test Facility (RFTF) has been designed and built to explore the behavior of Stirling-engine components under realistic reversing-flow conditions. The facility consists of four major parts: (1) Mechanical Drive - two cylinders with cam-driven pistons which generate the reversing gas flow, (2) Test Section - a U-shaped section containing the various test components and connected to the gas flow, (3) Instrumentation - high-speed instruments to measure gas pressure and temperature, piston positions, and other system parameters, and (4) Data Acquisition System - a computer-based system to acquire, store, and manipulate the data. The RFTF uses helium as the working gas and can achieve hot-side temperatures to 800°C, pressures to 8.0 MPa, flow-reversal frequencies to 50 Hz, and piston displacements between 9 and 72 cm^3. Results to date have been at ambient temperature, with pressure up to 6.0 MPa. Pressure drops across various components show a complex dependence on mass flowrate and frequency.

8318 **(DOE/NASA—0311-1) Ceramic Automotive Stirling Engine Program.** (Mechanical Technology, Inc., Latham, NY (USA)). Aug 1986. Contract AI01-85CE50112. 183p. (NASA-CR—175042; MTI—85SESD24). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87002994.

The Ceramic Automotive Stirling Engine Program evaluated the application of advanced ceramic materials to an automotive Stirling engine. The objective of the program was to evaluate the technical feasibility of utilizing advanced ceramics to increase peak engine operating temperature, and to evaluate the performance benefits of such an increase. Manufacturing cost estimates were also developed for various ceramic engine components and compared with conventional metallic engine component costs.

8319 **An analysis of pressure drops under reversing flow conditions.** Krazinski, J.L.; Holtz, R.E.; Uherka, K.L.; Lottes, P.A. (Argonne National Lab., Argonne, IL 60439). pp 519-525 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract W-31-109-ENG-38.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper examines pressure-drop data from the Reversing Flow Test Facility (RFTF) at Argonne National Laboratory (ANL). The data comprise part of an initial series of measurements conducted with pressurized helium gas under reversing flow conditions. The characteristics of fluid pressure drops in compressible, reversing flows are discussed in the paper and compared with pressure-drop measurements for steady, incompressible flows. The methodology used to calculate instantaneous mass flows in the test section of the RFTF is summarized. The measured pressure drops are analyzed in terms of their frictional and inertial components. Pressure-drop data are presented for both tubes and wire mesh regenerators over a range of flow reversal frequencies. The results are discussed with reference to other experimental data and analytical models available in the literature.

8320 **Heat transfer to single- and double-row Stirling engine heater tubes.** Connelly, M.; Olsson, G. (Mechanical Technology Inc., Latham, NY 12110). pp 526-532 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

As part of the Automotive Stirling Engine (ASE) Development Program conducted by Mechanical Technology Incorporated, heat transfer tests were performed in order to choose a specific Mod II (second generation) Stirling engine heater head geometry and to examine the interactive effects between this engine's two rows of tubes. The results are compared to simulated Mod I geometry and the available literature. A test section having a row of concentric tubes with a barrier gas in the annulus and water flowing through the inner tube was used to simulate the heat transfer from the combustion gas to the Striling engine's working gas. Five finless front row and two finned rear row geometries were tested, both individually and together, over a range of operating conditions. The results showed enhanced heat transfer for the Mod II Stirling engine heater head geometry as compared to the Mod I engine geometry. A more efficient Mod II rear row accounts for 10 to 50% improvements in the number of heat transfer units (NTU). Dimensionless heat transfer parameters were obtained and compared to the available literature. A single relationship between Nusselt and Reynolds numbers was found for the front row geometries. This relationship gives almost 50% higher Nusselt numbers than that predicted in the literature. It is speculated that this difference stems from a small amount of radiative heat transfer and the presence of combustion products rather than hot air.

8321 **Measurements with the reversing flow test facility.** Roach, P.D. (Argonne National Lab., Argonne, IL 60439). pp 539-544 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract W-31-109-ENG-38.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The Reversing Flow Test Facility (RFTF) has been designed and built to explore the behavior of Stirling-engine components under realistic reversing-flow conditions. The facility consists of four major parts: (1) Mechanical Drive - two cylinders with cam-driven pistons which generate the reversing gas flow; (2) Test Section - a U-shaped section containing the various test components and connected to the gas flow; (3) Instrumentation - high-speed instruments to measure gas pressure and temperature, piston positions, and other system parameters; and (4) Data Acquisition

System - a computer-based system to acquire, store, and manipulate the data. The RFTF uses helium as the working gas and can achieve hot-side temperatures to 800°C, pressures to 8.0 MPa, flow-reversal frequencies to 50 Hz, and piston displacements between 9 and 72 cm/sup 3/. Results to date have been at ambient temperature, with pressure up to 6.0 MPa. Pressure drops across various components show a complex dependence on mass flowrate and frequency.

8322 **Evaluation of Stirling engine appendix gap losses.** Huang, S.C.; Berggren, R. (Mechanical Technology Inc., 968 Albany-Shaker Road, Latham, NY 12110). pp 562-568 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The efficiency of a Stirling engine can be strongly influenced by the heat transfer losses associated with its appendix gap region. The cyclic energy flows in this region are related to the temperature gradient along the piston and cylinder partition walls, the reciprocating motion of the piston, the pressure variation in the Stirling cycle and the leakage flow across the cold-end seal. This paper outlines a numerical model to simulate these cyclic energy flows and the subsequent effort to correlate it with engine test data. The sensitivity of the appendix gap loss to selected parameters and comparisons with test results are presented.

8323 **A Stirling engine analysis method based upon moving gas nodes.** Martini, W.R. (Martini Associates, 2303 Harris Avenue, Richland, WA 99352). pp 569-574 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A little used method of analysis based upon moving gas nodes is explained. The number of time steps and the number of gas nodes needed for accurate results have been determined by comparison with the Schmidt equation. Using this analysis method, a comparison was made between: 1) the usual Stirling engine with flow-through heat exchangers and open hot and cold spaces and, 2) an isothermalized engine with interleaving fins in both the hot and cold gas spaces. About the same efficiency was calculated for the best designs of both types. However, these best designs have a much larger regenerator than have been used by engines described in the literature. This less common method of analysis was chosen because it is adaptable to isothermalized as well as conventional engines. This method will now be more fully explained. The process of validating this method is given. The application of the method to conventional Stirling engines and isothermalized Stirling engines is presented. Use of the method to find the best design for these two different types of Stirling engines is presented and discussed.

8324 **Stirling engine performance optimization with different working fluids.** Daley, J.G.; Marr, W.W.; Heames, T.J. (Argonne National Lab., Argonne, IL 60439). pp 575-581 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract W-31-109-ENG-38.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The design flexibility of Stirling cycle devices is evident from the wide variety of mechanical configurations that have been developed as well as the many differing applications that have been shown to be technically feasible. The choice of working fluid is one option that strongly influences engine design. Hydrogen permits the most compact engine (for a given power output and efficiency) of any gaseous working fluid investigated and has therefore been the choice in Stirling development programs directed at the automotive application where engine size is a major concern. Systems using helium or air are presently under development for applications where size is not as important a consideration. This paper describes calculated characteristics of engines optimized for four working fluids (hydrogen, helium, air and methane). A comparison is given between engines whose exterior dimensions are minimized and with lower rpm, lower pressure engine designs calculated by maximizing the dimensionless parameter known as the Beale number. Design point power and efficiency are the same in the resulting eight conceptual designs but greater variation is shown in engine characteristics due both to working fluid differences and to the two different design objectives.

8325 **Fluidyne pumping engine with minimal tuning line.** West, C.D. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 604-609 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—). Contract AC05-84OR21400.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Previous designs for large liquid piston Stirling engines (fluidynes) for pumping have required a bulky and expensive tuning line, which contributed significantly to the power losses in the machine and thereby significantly reduced the efficiency. In this paper, a liquid feedback fluidyne is described in which the pump is gas-coupled to the working space, and the tuning line serves only to maintain oscillations in the displacer column. The pumped liquid itself acts as the power piston by providing the major volume changing element of the system. The basic dimensions for the specific example used to illustrate the system are similar to two large fluidynes whose construction and operation are reported in the open literature; it is, therefore, easy to compare the new design with previous ones.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 8224

3306 Vehicle Design Factors

8326 **Liquid metal thermoacoustic engine.** Swift, G.W.; Migliori, A.; Wheatley, J.C. (Condensed Matter and Thermal Physics Group, Los Alamos National Lab., Los Alamos, NM 87545). pp 32-37 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The authors are studying a liquid metal thermoacoustic engine both theoretically and experimentally. This type of engine promises to produce large quantities of electrical energy from heat at modest efficiency with no moving parts. The only motion is associated with acoustic oscillations in the liquid metal. It is a new concept in energy conversion. A sound wave is usually thought of as consisting of pressure oscillations, but always attendant to the pressure oscillations are temperature oscillations. The combination produces a rich variety of "thermoacoustic" effects. These effects are usually so small that they are never noticed in everyday life; nevertheless under the right circumstances they can be harnessed to produce powerful heat engines, heat pumps, and refrigerators. In the authors' liquid metal thermoacoustic engine, heat flow from a high temperature source to a low temperature sink generates a high-amplitude standing acoustic wave in liquid sodium. This acoustic power is converted to electric power by a simple magneto-hydrodynamic effect at the acoustic oscillation frequency. The authors have developed a detailed thermoacoustic theory applicable to this engine, and find that a reasonably designed liquid sodium engine operating between 700°C and 100°C should generate about 60 W/cm/sup 2/ of acoustic power at about 1/3 of Carnot's efficiency.

8327 **Partial adiabatic cycle heat loss.** Colgate, S.A. (Los Alamos National Lab., Los Alamos, NM 87544). pp 331-335 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The cyclic loss of the motored cylinder is discussed in theory and in measurement. When a given mass of gas is alternately compressed and expanded, the process should be approximately adiabatic. Losses due to heat transfer give rise to a loss, which is a fraction of the reversible energy exchanged per cycle. The fractional loss or departure from adiabaticity is determined by a time-dependent heat transfer to and from the walls. This loss can be parameterized in terms of the Reynolds number of the effective gas dynamics in the cylinder and the compression ratio. This Reynolds number is composed of the maximum piston velocity, the cylinder diameter, and the kinematic viscosity of the gas. The velocity, composition of the gas, and pressure can be varied over a wide range of values. Thus, the fractional cycle loss can be parameterized as a function of Reynolds number and compression ratio.

3307 Emission Control

REFER ALSO TO CITATION(S) 8293

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 8316

36 MATERIALS

REFER ALSO TO CITATION(S) 8405

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 7893, 7908, 7956, 8168, 8168, 8266, 8274, 8400, 8400, 8442, 8442, 8452

8328 **(AD-A—172140/6/XAB) Alloy development, processing and characterization of devitrified titanium-base microcrystalline alloys. Annual report, September 1984-August 1985.** Whang, S.H. (Northeastern Univ., Boston, MA (USA). Barnett Inst. of Chemical Analysis and Materials Science). Jan 1986. 17p. NTIS, PC A02/MF A01.

The effect of rapid solidification on solid solubility, microstructural refinement, and phase transformation in binary and ternary titanium alloys was studied. The stability of the refined microstructures produced by rapid quenching were investigated under the isothermal and isochronal conditions. In particular, Ostwald ripening of rare earth (Y, La, Er) and thorium dispersoids in Ti-Sn-X (Y, La, Er, Th) systems at elevated temperatures (700-900 C, phase) was investigated by transmission electron microscopy and image analyzer. The grain growth rate at the presence of the rare earth and Th dispersoids was investigated and determined as a function of time. The deterioration of microhardness in the ternary alloys containing rare earth dispersions upon high-temperature annealing was studied in relation to microstructural coarsening.

8329 **(CERN-EP—86-133) Lattice and grain-boundary diffusion of ^{121}Te in silver after radioisotope implantation at the ISOLDE.** Geise, J.; Mehrer, H.; Herzig, C.; Weyer, G. (Muenster Univ. (Germany, F.R.). Inst. fuer Metallforschung; Aarhus Univ. (Denmark). Inst. of Physics). 22 Sep 1986. 7p. (CONF-860953—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900142.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

Lattice and grain-boundary diffusion of ^{121}Te in Ag were measured over a wide temperature range after implanting the radioisotope into single- and polycrystalline Ag samples with the ISOLDE. The values of the preexponential factor (0.21 cm^2s^{-1}) and the activation enthalpy (155 kJ mol^{-1}) for lattice diffusion are in line with previous measurements of impurity diffusion of Cd, In, Sn, and Sb in Ag and correspond to a vacancy mechanism of diffusion. For polycrystalline samples the product P=sδD/sub GB//sup */ (D/sub GB//sup */=grain-boundary diffusivity, s=segregation coefficient, δ=grain-boundary width) was determined from the type B kinetics of grain-boundary diffusion for temperatures above 650°K. At lower temperatures due to the large segregation coefficient, type C kinetics of grain-boundary diffusion was observed, which permits a determination of D/sub GB//sup */ itself. By comparing D/sub GB//sup */ with P the segregation coefficient of Te in Ag was estimated.

8330 **(CONF-860746—10) Band structure aspects of materials with localizing f-orbitals.** Koelling, D.D.; Norman, M.R.; Arko, A.J. (Argonne National Lab., IL (USA)). Jun 1986. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001547.

From Anomalous rare earths and actinides; Grenoble, France (7 Jul 1986).

In those materials where the f-states are hybridized, a band structure provides a reasonable description of the ground state. This is amply demonstrated by the successful determination of the Fermi surfaces of $CeSn_3$, URh_3, UIr_3, and UGe_3. But when the f-states become more local, inadequacies of the functionals employed yield incomplete localization. Thus, to obtain a good description of the Fermi surface for high field ferromagnetic CeSb, the local character of the f-orbitals is artifically forced to produce the standard rare earth model. When dealing with excited states, the ground state band structure provides only part of the story. Even thermal excitations can provide significant departures from the ground state as evidenced by the large enhancements found for some materials. The series USi_3, UGe_3, and USn_3 (together with $CeSn_3$) demonstrate the effect very well. $NpSn_3$ provides a useful counter example demonstrating that such enhancements need not be a universal property of localization.

8331 **(CONF-860953—3) Positron annihilation spectroscopy of vacancies in Ni_3Al.** DasGupta, A.; Smedskjaer, L.C.; Legnini, D.G.; Siegel, R.W. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38;AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002168.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

Lifetime and Doppler-broadening measurements on polycrystalline Ni_3Al with varying contents of Al(24, 25, and 26 at.%) and boron (0, 100, and 500 wt. ppM) have indicated that small concentrations (of order 10^{-6} to 10^{-5} at. fraction) of constitutional vacancies are present in nominally stoichiometric and hyperstoichiometric (>25 at.% Al) Ni_3Al and that boron can precipitate at these vacancies. However, no constitutional vacancies were indicated in hypostoichiometric (<25 at.% Al) Ni_3Al, and no manifestation of boron precipitation was found. The implications of these results with respect to vacancies in ordered alloys and the problems of synthesizing ductile Ni_3Al are discussed.

8332 **(CONF-861019—15) The effect of interaction range on the W(001) surface reconstruction phase transition.** Roelofs, L.D.; Wendelken, J.F. (Oak Ridge National Lab., TN (USA); Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin (Germany, F.R.)). Nov 1986. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002623.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

A model for the W(001) surface reconstruction phase transition is studied to elucidate the dependence of transition temperature on interaction range and other model parameters. For the parameter set chosen extending the range of the interaction without changing the total reconstruction energy increases the model transition temperature somewhat. This reduces a previously reported discrepancy between the experimental transition temperature and that consistent with the calculated reconstruction energy, but only marginally. 12 refs., 1 fig., 1 tab.

8333 **(CONF-870109—1) Effect of initial state on the aging behavior of austenitic stainless steel filler metal.** David, S.A.; Vitek, J.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014217.

From International welding conference; Tiruchchirappalli, India (12 Jan 1987).

Type 308 stainless steel is commonly used as a filler metal for austenitic stainless steel weldments. Welds produced by conventional processes contain a duplex austenite plus ferrite microstructure. However, after a solution anneal, the welds may contain a fully austenitic microstructure without ferrite. The elevated temperature stability of this steel was investigated after aging between 550 and 850°C for up to 10,000 h. Three different initial conditions were examined: solution annealed and quenched; solution annealed, quenched, and cold worked; and as-welded.

8334 (CONF-8508208—) **Nordic symposium on corrosion in seawater systems and on corrosion in hot-water systems in Nordic power plants.** 1985. 171p. (In English and Norwegian). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

The symposium proceedings contain seven papers covering the following subjects: A compilation of experiences of corrosion in Nordic power plants; Environment sensitive cracking in light water reactor pressure boundary materials; Stress corrosion cracking of age-hardenable nickel-base alloys in LWR conditions; Effect of tempering on corrosion resistance of cast aluminium bronzes; Experiences of corrosion in different seawater cooling systems in the Nordic countries; Corrosion problems in copper alloy condenser tubes; An evaluation of accelerated tests used for steels for seawater applications. Separate abstracts were prepared for each paper of the proceedings.

8335 (CONF-8508208—, pp 14) **Effect of tempering on corrosion resistance of cast aluminium bronzes.** Aaltonen, P.; Klemeth, K.; Haenninen, H. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

The subject of this study is corrosion resistance of aluminium bronzes, which are copper base alloys containing aluminium up to 12% with additions of nickel, iron and manganese. The main conclusions that can be drawn are: (1) The dealloying corrosion resistance of nickel-aluminium bronze is much better than that of aluminium bronze with iron and manganese additions, but it is not immune; (2) The dealloying corrosion resistance of aluminium bronzes can be improved by appropriate heat treatments. The best properties were obtained by tempering between 600-700 deg. C, depending on the initial microstructure; (3) In crevice conditions, where local acidification can occur, dealloying of aluminium bronzes is a consequence of the preferential attack at aluminium-rich phases. By appropriate tempering a uniform distribution of aluminium rich phases is obtained and the continuous path for selective corrosion is not formed. 5 references.

8336 (CONF-8508208—, pp 25) **Experience of corrosion and corrosion protection in seawater systems in the Nordic countries.** Henrikson, S. 1985. (In Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

A summary is given of the experience of the corrosion resistance of pumps, heat exchangers, valves and pipings in different seawater cooling systems in Denmark, Finland, Norway and Sweden. For pumps and heat exchangers the experience have been so extensive that a clear picture of today's status can be given. Owing to more scanty data concerning valves and pipes the survey of the corrosion in these components is less well substantiated. The commonest pumps in the cooling systems of power stations are vertically extended shaft pumps. To counteract corrosion on column and casing with organic surface coating and on stainless steel shafts and impellers under shutdown conditions, these should be provided with internal and external cathodic protection. For heat exchangers, both tube and plate, titanium has proved to be far and away the best choice. In the optimal blanket solution for a titanium heat exchanger the tubes are seal-welded to tube shuts of explosion-bonded titanium clad steel. Pipings of rubber-lined carbon steel or thick coatings og solvent-free epoxy resin have shown very good corrosion resistance in the seawater systems of power stations. Valves in seawater cooling systems have been affected, in particular, by corrosion due to defectively executed or damaged organic coating on cast iron. Different seawater-resistant bronzes (gunmetal, tin, bronze and aluminium bronze) are therefore preferable as valve material. 14 references.

8337 (CONF-8508208—, pp 30) **Compilation of experiences of corrosion in Nordic nuclear power plants.** Norring, K.; Rosborg, B. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

The fourteen nuclear reactors in commercial operation in the Nordic countries exhibit a great variety of corrosion induced damages. The largest number of such damages have affected turbine plants and seawater cooling systems. More severe cases of corrosion, which have been experienced, are intergranular stress corrosion cracking of steam generator tubing, stainless steel piping, high strength bolts and screws, and erosion-corrosion of structural steel in turbine plants. In all units in operation some form of corrosion damage has occured. In a worldwide perspective the corrosion problems in the Nordic nuclear power plants have been of manageable extent. This compilation of corrosion problems in Nordic light water reactors has been performed within the Safety Program of the Nordic Liaison Commithe for Atomic Energy. 40 references.

8338 (CONF-8508208—, pp 24) **Environment sensitive cracking in light water reactor pressure boundary materials.** Haenninen H.; Aho-Mantila, I. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

The purpose of this paper is to review the available methods and the most promising future possibilities of preventive maintenance to counteract the various forms of environment sensitive cracking of pressure boundary materials in light water reactors. Environment sensitive cracking is considered from the metallurgical, mechanical and environmental point of view. The main emphasis is on intergranular stress corrosion cracking of austenitic stainless steels and high strength Ni-base alloys, as well as on corrosion fatique of low alloy and stainless steels. Finally, some general ideas how to predict, reduce or eliminate environment sensitive cracking in service are presented. 37 references.

8339 (CONF-8508208—, pp 16) **Stress corrosion cracking of age-hardenable nickel base alloys in LWR-conditions.** Kekkonen, T.; Haenninen, H. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

At present it seems that the microstructure most resistant to stress corrosion cracking (SCC) in high-temperature water, is obtained by a solution annealing treatment at a relatively high temperature (ca 1100 deg. C), followed by water quenching and a single aging treatment (ca 700 deg. C/20h). However, since the actual mechanism of SCC in age-hardenable nickel base alloys is unclear, the microstructural features resulting in the good resistance to SCC cannot be specified. Furthermore, the possible microstructural changes caused by prolonged use in LWR-conditions, are unknown. Based on this review, future research should concentrate on the following subjects: (1) The effect of processing and heat treatment of the microstructure, mechanical properties and SCC resistance; (2) The mechanism of crack initiation and growth during SCC in age-hardenable nickel base alloys, both in BRW- and PWR-conditions; (3) The role of impurity regregation in SCC initiation and growth; (4) The effects of hydrogen absorption on mechanical properties; (5) The changes occuring during long term use (irradiation, low temperature sensitization). 22 references.

8340 (CONF-8508208—, pp 7) **Corrosion problems in copper alloy condenser tubes. Experiences from Danish power stations, refineries, chemical plants and ships.** Christensen, C. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

An overview is presented of the two major causes of condenser outages in power plants and ship born installations, viz erosion and pitting corrosion, and the parameters that govern the attacks. Finally, some remedial measures are given in the form of suggested specifications for shell and tube heat exchangers, based upon experience gained in Denmark. By using them, it should be possible to continue to use the cheaper copper alloy condensers as compared to titanium and super stainless steels.

8341 (CONF-8508208—, pp 47) **Evaluation of accelerated tests used for steels for seawater applications.** Videm, K. 1985. (In English and Swedish). NTIS (US Sales Only), MF A01. File Number DE87750371.

From Nordic symposium on corrosion protection in seawater systems and on corrosion in hot-water systems in Nordic power plants; Kjeller, Norway (27 Aug 1985).

Accelerated tests for the evaluation of the resistance of stainless steels and high performance alloys to pitting and crevice corrosion have been critically reviewed. Some of the difficulties in evaluating the results from accelerated corrosion testing have an administrative origin, i.e. agreements on all relevant tests parameters have not been reached, on the standards are not followed on all points. There also exist technical problems which are not satisfactorily solved for electrochemical tests. Immersion tests are simpler, and a good data base exist for FeCl3 testing. Corrosion damage due to long period of stagnancy is very important in practice. Despite this, tests for studying resistance to stagnant corrosion are not available. This is pointed out as the most severe shortcoming with respect to accelerated testing of stainless steels for seawater applications. 38 references.

8342 (CONF-8606101—10) **Metastable phase formation in nickel-aluminum alloys during ion beam mixing.** Eridon, J.; Rehn, L.; Was, G. (Argonne National Lab., IL (USA); Michigan Univ., Ann Arbor (USA)). Aug 1986. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001554.

From 5. international conference on ion beam modification of materials; Catania, Italy (9 Jun 1986).

Phase transformations induced by ion beam mixing of nickel-aluminum alloys with 500 keV krypton ions have been investigated over a range of temperatures, compositions, and initial structures. Samples were formed by alternate evaporation of layers of nickel and aluminum. A portion of these samples was subsequently annealed to form intermetallic compounds. Irradiations were performed at both room temperature and 80°K using the 2 MV ion accelerator at ANL. Phase transformations were observed during both in-situ irradiations in the High Voltage Electron Microscope at Argonne and also in subsequent electron diffraction analysis of an array of irradiated samples. Metastable phases formed include disordered crystalline structures, an amorphous structure, and a hexagonal close-packed structure. These phase structures were modeled using the embedded atom method to compute energies of transition from stable to metastable states. The effects of both thermodynamics and kinetics on metastable phase formation are evaluated.

8343 (DOE/ER/45141—T3) **Fatigue-induced nanoscale patterns and microstructures.** Gerberich, W.W.; Sheth, J.K.; Kaczorowski, M. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1986. Contract FG02-84ER45141. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001877.

Dislocation patterns as produced by monotonic loading of polycrystalline aluminum or fatigue loading of a low-alloy ferritic steel have been evaluated. A proposed theoretical model involves an accounting procedure based upon dislocations emanated at grain boundary sources being stored in dislocation patterns as a series of subcells. Near equilibrium, the scale parameters are roughly 100 μm grains being divided into 1μ subcells which contain dislocations spaced at about 10 nm intervals within the cell walls. Pattern generation and dislocation spacings are dictated by the quasi-static state of equilibrium during the work-hardening phase of the loading. Experimental nanometer-scale probes, used in the fatigue study, consisted of three forms of electron microscopy. The first involved direct imaging of intersecting slip at the free surface of electropolished samples, using channeling contrast from back-scattered electrons (BSE). The second involved the use of selected-area electron channeling patterns (SACP's) to evaluate crystallography and defect densities, while the third directly evaluated cell sizes and dislocation spacings with transmission electron microscopy of thin films (TEM). BSE, SACP and TEM probes determined dislocations to be packed into cell walls with a wave length of 0.78 μm and an interwall spacing of 33 nm, consistent with the theoretical model. BSE channeling contrast revealed elliptical patterns to develop within single grains and SACP's verified that these were sharp valleys with a crystallographic misorientation of 17° across the valley. One of those was shown to lead to fatigue crack nucleation in a transgranular mode.

8344 (DP-MS—86-111) **Galvanic corrosion resistance of welded dissimilar nickel-base alloys.** Corbett, R.A.; Morrison, W.S.; Snyder, R.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1986. Contract AC09-76SR00001. 30p. (CONF-861188—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002656.

From Symposium on galvanic corrosion; Phoenix, AZ, USA (4 Nov 1986).

A program for evaluating the corrosion resistance of various dissimilar welded nickel-base alloy combinations is outlined. Alloy combinations included ALLCORR, Hastelloy C-276, Inconel 72 and Inconel 690. The GTAW welding process involved both high and minimum heat in-put conditions. Samples were evaluated in the as-welded condition, as well as after having been aged at various condtions of time and temperature. These were judged to be most representative of process upset conditions which might be expected. Corrosion testing evaluated resistance to an oxidizing acid and a severe service environment in which the alloy combinations might be used. Mechanical properties are also discussed.

8345 (INIS-SU—352, pp 191-194) **Studying the properties of niobium surface as applied to superconducting RF accelerating structure development.** Komkov, A.A.; Orlov, A.K.; Smirnov, V.L.; Sokolov, B.A.; Tsygankova, T.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Dependences of ratio of a near the surface resistances γsub(s) and niobium surface impurity on treatment technique are studied in the framework of works in the development of superconducting linac with the energy of 3-5 MeV. Samples are considered, for which semifinishing and finishing turning, chemical and electrochemical polishing, vacuum annealing, and also electrochemical polishing+oxidation are used. Dependences of dynamic magnetic permeability μ(H) and magnetization M(H) are presented. The amounts of impurities in the near the surface layer are: 0-40 ppm, C-5 ppm, N-<5 ppm, W-12 ppm, Mo-<1 ppm, Ta-70 ppm. A conclusion is drawn that finishing turning is disadvantageous as compared to semifenishing one in spite of higher degree of roughness in the first case. In chemical polishing (50 μm larer is taken off) and the successive electrochemical treatment (50 μm layer is taken off) the γsub(s) value grows. This is associated with incomplete removal of a cold-hardened layer, with hydrogen introduction and hydraulic formation at low temperatures. γsub(s) value drops after the process of vacuum annealing probably due to surface enrichment with oxygen.

8346 **(LA-UR—86-2003) Couple effect between creep and plasticity of type 316 stainless steel at elevated temperature.** Kawai, M.; Ohashi, Y. (Los Alamos National Lab., NM (USA); Nagoya Univ. (Japan); Aichi Inst. of Tech., Yachigusa, Yagusa-cho, Toyota (Japan)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870103—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012375.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

Interaction between creep and plastic strains is discussed for metallic materials at elevated temperature. We first estimate qualitatively an applicability of representative unified constitutive equations to combined creep and plastic deformations. Then, some actual creep-plasticity interaction of type 316 stainless steel is shown in comparison with predicted results.

8347 **(LBL—21788) Specific heat of heavy Fermion superconductors under pressure.** Olsen, J.A.; Fisher, R.A.; Phillips, N.E.; Stewart, G.R.; Giorgi, A.L. (Lawrence Berkeley Lab., CA (USA); Florida Univ., Gainesville (USA); Los Alamos National Lab., NM (USA)). May 1986. Contract AC03-76SF00098. 6p. (CONF-8606149—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002564.

From 2. workshop on actinides under pressure; Karlsruhe, F.R. Germany (2 Jun 1986).

We have performed high precision measurements of the specific heats of UPt_3 and UBe_{13} between 0.4 and 20°K for pressures up to 9.3 kbar.

8348 **(LBL—21789) Heavy-fermion, kondo, spin glass-like, and antiferromagnetic behavior in (Ce,Gd)Al/sub 3/.** Edelstein, A.S.; Holtz, R.L.; Gillespie, D.J.; Fisher, R.A.; Phillips, N.E. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 19p. (CONF-860746—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002567.

From Anomalous rare earths and actinides; Grenoble, France (7 Jul 1986).

We have found that Ce/sub 1-x/Gd/sub x/Al_3 with x = 0.23 is a heavy-fermion system which undergoes a spin glass transition. The amplitude of the peak in the susceptibility that characterizes the spin glass transition passes through a sharp maximum at x = 0.5. For x = 0.635 and 0.77 the system undergoes a spin glass-like transition at 100°K and an antiferromagnetic transition at 20°K.

8349 **(LBL—22239) Magnetic and electronic properties of transition-metal surfaces and overlayers.** Victora, R.H. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Jan 1986. Contract AC03-76SF00098. 16p. (CONF-860153—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002577.

From International workshop on the magnetic properties of low dimensional systems; Taxco, Mexico (6 Jan 1986).

Results of calculations for the magnetic and related electronic properties of transition-metal surfaces and overlayers are presented for a variety of systems. They involve Co, Fe, and Cr in a diversity of forms, including alloys, metastable configurations, and overlayers on nonmagnetic metals. The overall behavior of these systems is interpreted in terms of four qualitative rules which are presented, analyzed, and illustrated.

8350 **(LBL—22444) The temperature dependence of the specific heat and entropy of $CeAl_3$.** Edelstein, A.S.; Fisher, R.A.; Phillips, N.E. (Lawrence Berkeley Lab., CA (USA); Naval Research Lab., Washington, DC (USA)). Oct 1986. Contract AC03-76SF00098. 16p. (CONF-861111—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002563.

From Conference on magnetism and magnetic materials; Baltimore, MD, USA (17 Nov 1986).

It is thought that with decreasing temperature $CeAl_3$ first condenses into a crystal-field J/sub Z/ = +-3/2 doublet ground state and then further condenses into a Kondo singlet state. To test this description, we use it to calculate the specific heat and entropy of $CeAl_3$. We calculate the specific heat contribution of the J/sub Z/ = +-5/2 doublet using the resonant level model. The contributions from the J/sub Z/ = +-5/2 and +-1/2 doublets are computed using the known crystal-field energies but allowing for a broadening of the levels. If it is assumed that the excited crystal-field states have Lorentzian distributions with a width of the order of 50K, the calculation is in generally good agreement with experimental data for the f-electron contribution. (The specific heat of $LaAl_3$, which was measured for the purpose and is reported here, was subtracted from the total to obtain the f-electron contribution.)

8351 **(MLM—3395) General purpose heat source (GPHS) clad vent set (CVS) formability study.** Forrest, M.A.; McDougal, J.R.; Saylor, R.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 3 Nov 1986. Contract AC04-76DP00053. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002682.

Primarily, Mound was to evaluate both improved-iridium and standard-flight iridium blanks with respect to current GPHS-CVS manufacturing processes and provide example-weld-quality CVS to the Savannah River Plant (SRP) for its weldability study. Additionally, Mound's practice of performing a final outgassing (1500°C for 1 hr) of CVS was evaluated with respect to metallurgical properties of iridium cups and electron-beam (EB) welding characteristics of CVS subassembly components.

8352 **(SAND—86-1826C) Influence of atomic corrugations on alkali chemisorption.** Shinn, N.D.; Szuromi, P.D. (Sandia National Labs., Albuquerque, NM (USA); National Bureau of Standards, Washington, DC (USA). Surface Science Div.). 1986. Contract AC04-76DP00789. 5p. (CONF-861019—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002491.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

In order to separate generic electronic effects from alkali-specific steric effects, experiments have been performed using potassium, sodium and lithium metals. This paper reports results using low energy electron diffraction (LEED), temperature programmed desorption (TPD), Auger electron spectroscopy (AES), and electron stimulated desorption ion angular distribution (ESDIAD) measurements. The Cu(311) surface was oriented to within 0.5° and cleaned in situ by repeated cycles of argon ion sputtering and annealing at 850K until a sharp (1x1) LEED pattern was obtained and Auger spectroscopy verified the absence of any contamination at the 1% noise level.

8353 **(UCRL—93993) Analogy between dislocation kinetics and microcrack kinetics across shock fronts.** Stout, R.B. (Lawrence Livermore National Lab., CA (USA)). May 1986. Contract W-7405-ENG-48. 9p. (CONF-870103—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010970.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

An analysis for propagating spatial discontinuities of microcrack density, mass density, momentum density, and energy density is described in terms of an analogy between dislocations and microcracks. Because of the statistical, kinematic, and energetic analogies, previously derived discontinuity conditions involving dislocation kinetics across shocks provide the necessary mathematical formalism and physical concepts for analog discontinuity conditions involving microcrack kinetics.

8354 **(UCRL—95474) Development of high-creep-strength molybdenum and tungsten alloys by the internal nitriding process.** Mitchell, J.B. (Lawrence Livermore National Lab., CA (USA)). 2 Oct 1986. Contract W-7405-ENG-48. 6p. (CONF-870102—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001361.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Substantial increases in the high-temperature creep strength of Mo-Hf alloys can be obtained by internal nitriding. The creep resistance of internally nitrided Mo-1.86 wt % Hf is more than 100 times greater than that of other commercially available molybde-

num-base alloys. The HfN precipitates appear to be stable over long times at temperatures near 1600 K. Internally nitrided Mo-Hf alloys appear to be good candidates for fabrication of components of space power systems where the ratio of high-temperature strength to weight is important. They are particularly good candidates for components that can be fabricated from the lower-strength unnitrided alloy and subsequently nitrided to provide high-temperature strength.

8355 **Low activation ferritic alloys.** Gelles, D.S.; Ghoniem, N.M.; Powell, R.W. (to Dept. of Energy, Washington, DC). US Patent 4,622,067. 11 Nov 1986. Filed date 7 Feb 1985. v.p.

This patent describes a ferritic alloy having a banitic or martensitic microstructure when heated treated and tempered and characterized by low activation properties, the alloy consisting essentially of: chromium-2.0 to 13 percent by weight; vanadium or, tungsten, or tantalum in a total amount of-0.3 to 1.5 percent by weight; carbon-0.75 to 0.30 percent by weight; manganese-0.01 to 15.0 percent by weight; silicon-0.05 to 1.0 percent by weight; phosphorous-less than 0.01 percent by weight; nitrogen-less than 0.04 percent by weight; sulphur-less than 0.01 percent by weight; copper-less than 0.003 percent by weight; molybdenum-less than 0.12 percent by weight; niobium-less than 0.003 percent by weight; nickel-less than 0.1 percent by weight; the remainder of the alloy being iron.

8356 **Process for forming unusually strong joints between metals and ceramics by brazing at temperatures that do not exceed 750 degree C.** Hammond, J.P.; David, S.A.; Woodhouse, J.J. (to Dept. of Energy, Washington, DC). US Patent 4,621,761. 11 Nov 1986. Filed date 4 Dec 1984. v.p.

A process is described for brazing high melting point iron-containing metals to ceramics at temperatures not greater than 750° C. comprising, in a vacuum: (a) cleaning a surface to be brazed of a ceramic to remove surface oxygen therefrom; (b) coating the cleaned surface of ceramic with a thin layer of an active substrate that is from 0.3 to 1 micron thick; (c) cleaning a surface to be brazed of a high-melting point iron-containing metal to remove any surface carbon therefrom; (d) coating the surface to be brazed of the metal with a thin noncarbon containing metal coating to prevent any carbon contained in the metal from reacting with a brazing alloy; (e) forming an assembly of the ceramic surface and the metal surface in sandwich fashion with a brazing alloy placed therebetween. The brazing alloy has a melting point of less than 750° C., wetting the metal surface and forming a trimetal intermetallic with the active substrate upon brazing; (f) heating the assembly to the melting point of the brazing alloy for a period suitable to permit flow and wetting by the brazing alloy; and (g) cooling the assembly to form a brazed joint between the ceramic surface and the metal surface.

8357 **Variations in the microstructure of nickel-based alloy coatings with the metalloids boron and silicon as a function of deposition parameters in a dual beam ion system.** Panitz, J.K.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **4**: No. 6, 2949-2953(Nov 1986). Contract AC04-76DP00789.

We have deposited coatings using a dual beam ion source system with two different targets as sputtering sources; (i) a predominantly amorphous Ni/sub 63.5/Cr/sub 12.3/Fe/sub 3.5/Si/sub 7.9/B/sub 12.8/ foil and (ii) a crystalline Ni/sub 55.3/Cr/sub 16.9/Si/sub 7.2/B/sub 21.6/ slab from a casting. Amorphous coatings were produced by the foil for all conditions studied. The coatings that were deposited from the slab target that were less than 400 nm in thickness which were deposited at rates from 8—50 nm/min appeared to be amorphous. The thicker (>400 nm) coatings and the extremely low deposition rate (2 nm/min) coatings produced by the slab comprised both partially polycrystalline and amorphous material. All of the coatings studied exhibited inferior wear and erosion resistance properties compared to iron-based amorphous metal coatings containing Ti, C, or N, which have been studied by other groups. However, the corrosion resistance to 4 N HCl is good, ranging from less than 0.01 to 0.22 mm/yr as a function of deposition rate, concurrent ion bombardment conditions, and coating thickness.

8358 **Structural unit in icosahedral MnAlSi and MnAl.** Ma, Y.; Stern, E.A.; Bouldin, C.E. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **57**: No. 13, 1611-1614(29 Sep 1986).

Experimental evidence from extended x-ray—absorption fine-structure measurements indicates that a cage of Mn atoms at the vertices of an icosahedron is the structural unit in the icosahedral MnSiAl and MnAl phases. The connections among these icosahedral units and between them and the Al atoms are different in the icosahedral and α phases. It is suggested that the i phase grows by randomly nucleating together Mn icosahedra along their twenty threefold directions, as allowed by local steric constraints.

8359 **Localized corrosion of stainless steels and nickel alloys in flue gas desulfurization environments.** Phull, B.S.; Lee, T.S. (LaQue Center for Corrosion Technology, Inc., P.O. Box 656, Wrightsville Beach, NC 28480). *Materials Performance;* **25**: No. 8, 30-35(Aug 1986).

The results of a planned interval test of 90 days duration in a model flue gas desulfurization system are discussed. Tests were conducted in a high chloride, limestone slurry-based environment containing fluoride and flyash. Corrosion in absorber and outlet duct zones is outlined in terms of relative tendencies of localized corrosion propagation for six alloys.

8360 **Tungsten and other refractory metals for VLSI applications.** Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). 571p. (CONF-8510238—). Materials Research Society, 9800 McKnight Road, Suite 327, Pittsburgh, PA 15237.

From Workshop on tungsten and other refractory metals; Albuquerque, NM, USA (7 Oct 1985).

This book presents the papers given at two conferences on tungsten and other refractory metals for VLSI applications. Topics considered include the microstructural characterization of low pressure chemical vapor deposition (LPCVD) tungsten films, properties of CVD tungsten films deposited at atmospheric and reduced pressures, the adhesion of tungsten films to dielectrics, crystal doping, sputtering, electrical properties, refractory metals, tungsten-silicon interactions, mathematical models, device applications, and the future of refractory metals in VLSI applications.

8361 **Suppression of the silicidation reaction between LPCVD tungsten films and silicon up to 1100°C.** Blewer, R.S.; Tracy, M.E. (Sandia National Labs., Albuquerque, NM 87185). pp 53-62 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8510238—). Contract AC04-76DP00789.

From Workshop on tungsten and other refractory metals; Albuquerque, NM, USA (7 Oct 1985).

The range of potential applications of LPCVD tungsten in integrated circuits could be considerably broadened if tungsten-silicon interfaces were thermally stable above 600°C. The authors have devised a reliable method to suppress the onset of the tungsten silicidation reaction to >1100°C by introducing controlled concentrations of oxygen near the metal-silicon interface. The temperature to which the onset of the reaction can be suppressed is dependent on doping level, but not on dopant type (phosphorous versus boron) nor on the monocrystalline of polycrystalline nature of the silicon substrate. Twenty atomic percent interfacial oxygen retards the onset of the silicidation reaction to above 850°C. Fifty atomic percent interfacial oxygen retards the onset of the silicidation reaction to above 1100°C. Details of the film deposition conditions and dopant distribution within the tungsten films at high temperature are given.

8362 **Plasma-enhanced deposition of metal films.** Hess, D.W. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA 94720). pp 105-114 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8510238—).

From Workshop on tungsten and other refractory metals; Albuquerque, NM, USA (7 Oct 1985).

Plasma-enhanced chemical vapor deposition (PECVD) has been widely used to deposit insulating and semiconducting films for electronic and optical devices. Because of the versatility of PECVD, this method has generated much recent interest for the formation of conducting layers for barrier, contact, and interconnect applications. Plasma deposition conditions that permit the synthesis of transition metals, transition metal silicides, transition metal nitrides, and other conducting layers are described. Emphasis is placed upon the relationship between plasma chemistry and physics, and the as-deposited resistivity and composition of the metal films.

8363 **Thick selective LPCVD tungsten: Techniques and characteristics.** Blewer, R.S.; Tracy, M.E.; Wells, V.A. (Center for Radiation Hardened Microelectronics, Sandia National Labs., Albuquerque, NM 87185). pp 407-422 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8411141—).

From Workshop on tungsten for VLSI applications; Albuquerque, NM, USA (12 Nov 1984).

Spatially selective tungsten films have been deposited in a hot wall LPCVD system in thicknesses ranging from 80 Angstroms to one micrometer. The electrical and microstructural properties of films deposited by sequential (two-step) and simultaneous (one-step) exposure to WF/sub 6/ and H/sub 2/ have investigated. Contact resistance measured for 400 A to 2400 A films on polysilicon and on n/sup +/ and p/sup +/ doped (100) silicon has been shown to be low and reproducible die to die, wafer to wafer, and run to tun. Leakage current measurements on one million square micron diodes with tungsten metallization are identical to Al-Si controls. TEM and SEM studies performed for different deposition conditions reveal only occasional detrimental interaction with the silicon substrate. Poly gates and source/drain regions have been covered selectively with LPCVD tungsten in shallow junction CMOS devices, and functional parts have been obtained. A discussion of these results as well as a consideration of factors which enhance selectivity and methods to regain selectivity, once lost, are given.

8364 **LPCVD tungsten deposition on Si-Ge alloy.** Wells, V.A.; Walko, R.J. (Sandia National Labs., Div. 2147, P.O. Box 5800, Albuquerque, NM 87185). pp 497-504 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8411141—).

From Workshop on tungsten for VLSI applications; Albuquerque, NM, USA (12 Nov 1984).

LPCVD has a number of advantages. It is a simpler process than sputtering. It appears to be self-cleaning, a distinct advantage over the more surface-condition-sensitive sputtering process. LPCVD does not mechanically damage the surface as does sputtering, and this may be responsible for the low initial contact resistance observed. Aging profiles tend toward the high end of the acceptance window. This may imply a higher activation energy and a longer lifetime.

8365 **The influence of deposition variables on LPCVD tungsten films deposited by the WF/sub 6//Si reduction reaction.** Tracy, M.E. (Kirk-Mayer, Inc., Albuquerque, NM 87185). pp 211-219 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8510238—).

From Workshop on tungsten and other refractory metals; Albuquerque, NM, USA (7 Oct 1985).

In an effort to isolate and study the Si reduction of WF/sub 6/ by the reduction reaction 2 WF/sub 6/ + 3 Si → 2 W + 3 SiF/sub 4/ a systematic study of the influence of temperature, substrate doping, deposition time and variable flow rates of tungsten hexafluoride (WF/sub 6/) was conducted. The effect of varying these parameters on film thickness, layer resistivity, encroachment and adhesion was investigated. A set of operating conditions has been defined that yield stable, adherent, self-limiting films of ~100A thickness that are free from encroachment. Film quality was found to be relatively insensitive to moderate variations in process parameters, a favorable indication in terms of process integration and manufacturability.

8366 **Hydrogen dissociation on transition metal surfaces: The effects of surface impurities.** Goodman, D.W.; Rye, R.R. (Sandia National Labs., Albuquerque, NM 87185). pp 93-104 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8510238—).

From Workshop on tungsten and other refractory metals; Albuquerque, NM, USA (7 Oct 1985).

The dissociative adsorption of hydrogen on transition metals has been the subject of considerable attention for a number of years by surface scientists. Much of the earlier work concerned the use of techniques such as temperature programmed desorption and work function measurements. These data have been successful in defining the kinetic parameters associated with the adsorption/desorption steps together with information regarding the nature of the metal-hydrogen bond. More recently molecular beam techniques have been employed to examine directly the existence and nature of the H/sub 2/ adsorption barrier. This paper presents a limited review of the present understanding of hydrogen dissociation on clean and chemically modified transition metals with emphasis on the authors' research. In particular, H/sub 2/ adsorption on clean tungsten and the influence of electronegative additives (e.g. S,O,C,P,N,Cl) on the chemisorption properties of nickel are described. In conclusion, the relevance of these studies to other transition metals is discussed.

8367 **Sputter deposition system for controlled fabrication of multilayers.** DiNardo, R.P.; Takacs, P.Z.; Majkrzak, C.F.; Stefan, P.M. (Brookhaven National Lab., Upton, NY 11973-5000). pp 30-35 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—). Contract AC02-76CH00016.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

A detailed description of a sputter deposition system constructed specifically for the fabrication of x-ray and neutron multilayer monochromators and supermirrors is given. One of the principal design criteria is to maintain precise control of film thickness and uniformity over large substrate areas. Regulation of critical system parameters is fully automated so that response to feedback control information is rapid and complicated layer thickness sequences can be deposited accurately and efficiently. The use of either DC or RF magnetron sources makes it possible to satisfy the diverse material requirements of both x-ray and neutron optics.

8368 **Structural study of multilayered vanadium/nickel superlattices.** Homma, H.; Lepetre, Y.; Murduck, J.M.; Schuller, I.K.; Majkrzak, C.F. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). pp 149-167 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

The authors have studied the microstructure of V/Ni metallic superlattice, using x-ray and neutron diffraction. They find a sharp and broad rocking curves around the first order Bragg peak, and attribute them to a columnar structure which gives rise to two modulation structures; one the ordinary layered structure within the columns and the other the averaged modulation structure which produces the sharp rocking peak.

8369 **Design and fabrication of carbon-tungsten multilayers using ellipsometry.** Ziegler, E.; Houdy, P.; Nevot, L. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). pp 306-316 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Recently, there has been increased interest in near normal incidence optical systems for use in the soft x-ray domain ($10A < \lambda < 100A$). This region of the x-ray spectrum is important because

many organic constituents have their K-absorption edges in this range. One important application of near normal incidence soft X-rays optical systems is lithography, for which 44.7A radiation is particularly well suited. Hence, the authors have concentrated their studies at this wavelength. Stacks of their alternating layers with low and high electron densities can be used to obtain mirrors with substantial reflection coefficients. The authors have developed a model to obtain the optical properties of such a stack in a fashion similar to that used for visible light. This model can be shown to be quite accurate for near normal incidence and for wavelengths long compared to the interatomic spacing. They have also shown from this model that a smooth, 200 layer, carbon-tungsten stack would provide a reflectivity of approximately 25% at 44.7A when used in normal incidence.

8370 **Preliminary investigation of changes in x-ray multilayer optics subjected to high radiation flux.** Hockaday, M.P.; Blake, R.L.; Grosso, J.S.; Selph, M.M.; Klein, M.M.; Matuska, W. Jr. (Physics Div., Los Alamos National Lab., Mail Stop D410, P.O. Box 1663, Los Alamos, NM 87545). pp 61-65 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

A variety of metal multilayers was exposed to high x-ray flux using Sandia National Laboratories PROTO II machine in the gas puff mode. Fluxes incident on the multilayers above 700 MW/cm/sup 2/ in total radiation, in nominal 20 ns pulses, were realized. The neon hydrogen- and helium-like resonance lines were used to probe the x-ray reflectivity properties of multilayers as they underwent change of state during the heating pulse. A fluorescer-fiver optic-streak camera system was used to monitor the changes in x-ray reflectivity as a function of time and irradiance. Preliminary results are presented for a W/C multilayer. Work in progress to model the experiment is discussed.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 8356

8371 **(DOE/ER/10950—T2) Erosion of structural ceramics: Final report.** Ritter, J.E. Jr.; Jakus, K. (Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering). Apr 1985. Contract AC02-81ER10950. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002820.

The effect of multiparticle impact at 23, 700, 1000°C on the erosion and strength degradation of sintered alumina was determined. Impact damage at normal incidence was characterized by numerous small pits consistent with grain boundary cracking. Room temperature erosion data for sintered SiC and hot pressed Al_2O_3, Si_3N_4, and MgO were analyzed to test the general applicability of the model.

8372 **(KFK—4063) Microstructure, grain boundaries and properties of sintered and isostatically hot pressed SiC-materials.** Hamminger, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Feb 1986. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87900160.

A comprehensive microstructural characterization of pressure-less sintered and isostatically hot pressed SiC-materials has been elaborated by means of microchemical and microanalytical methods. Grain boundary analyses were conducted by means of high resolution Auger electron spectroscopy.

8373 **(LBL—22368) Grain boundaries and interfaces: Some applications of electron microscopy and microanalysis.** Thomas, G. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Sep 1986. Contract AC03-76SF00098. 29p. (CONF-860714—6). NTIS, PC A03. File Number DE87002550.

From 22. University conference on ceramics - ceramic microstructures '86: role of interfaces; Berkeley, CA, USA (28 Jul 1986)

In this paper some typical examples have been shown where the need for combined characterization techniques especially for grain boundaries and interphase interfaces has been emphasized. There is no doubt that great progress has been made in the use of electron microscopy in ceramics research this past decade. However, it is essential that combined efforts of research and development are made that are equally intensive in all aspects. It is especially important for processing and characterization to be very closely linked in order to design better microstructures, controlled interfaces, and properties.

8374 **(N—86-31377) Computer simulation of surface and film processes. Final report, 1 May 1981-30 April 1984.** Tiller, W.A.; Halicioglu, M.T. (Stanford Univ., CA (USA)). Nov 1984. 75p. (NASA-CR—176966; NAS—1.26:176966; SU-DMS—85-R-1). NTIS, PC A04/MF A01.

All the investigations which were performed employed in one way or another a computer simulation technique based on atomistic level considerations. In general, three types of simulation methods were used for modeling systems with discrete particles that interact via well defined potential functions: molecular dynamics (a general method for solving the classical equations of motion of a model system); Monte Carlo (the use of Markov chain ensemble averaging technique to model equilibrium properties of a system); and molecular statics (provides properties of a system at T = 0 K). The effects of three-body forces on the vibrational frequencies of triatomic cluster were investigated. The multilayer relaxation phenomena for low index planes of an fcc crystal was analyzed also as a function of the three-body interactions. Various surface properties for Si and SiC system were calculated. Results obtained from static simulation calculations for slip formation were presented. The more elaborate molecular dynamics calculations on the propagation of cracks in two-dimensional systems were outlined.

8375 **Process for preparing fine grain titanium carbide powder.** Janey, M.A. (to Dept. of Energy, Washington, DC). US Patent 4,622,215. 11 Nov 1986. Filed date 12 Mar 1985. v.p.

This patent describes a method for preparing titanium carbide powder of a purity greater than 99.9% in a submicron particle size range. The method comprises forming a mixture consisting essentially of a liquid organotitanate or an organititanate in solution and a solution of carbon precursor polymer. The organotitanate and the carbon precursor polymer are in essentially stoichiometric concentrations with respect to titanium and carbon. The organotitanate provides a crosslinking reaction with the carbon precursor polymer for forming a gel, heating the gel to successively dry the gel, drive volatile components from the gel and pyrolyze the polymer to form free carbon, and thereafter heating the remaining components of the gel to a temperature sufficient to convert the titanium and carbon to titanium carbide powder.

8376 **Studies of interfacial composition of TiN films formed by plasma-assisted chemical vapor deposition using an in-situ scratching device.** Hilton, M.R.; Middlebrook, A.M.; Rodrigues, G.; Salmeron, M.; Somorjai, G.A. (Center for Advanced Materials, Lawrence Berkeley Laboratory, and Department of Materials Science and Mining Engineering and Department of Chemistry, University of California at Berkeley, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **4**: No. 6, 2797-2800(Nov 1986). Contract AC03-76SF00098.

The interfacial composition of plasma-assisted chemical vapor deposited TiN films on M2 tool steel is reported. An in-situ scratcher with a scratch adhesion test type diamond stylus was used to create scratches in ultrahigh vacuum (UHV). Auger electron spectroscopy analysis of the adhesive mode failures revealed a sharp chlorine concentration gradient at the exposed surface representing the prior interface. The scratch removal technique data is compared to sputter depth profile data. Scanning electron microscopy and energy dispersive spectroscopy investigation of the scratches following the UHV work is also presented and discussed.

8377 **Predicted wear resistances of binary carbide coatings.** Kramer, B.M. (George Washington University, Washington, DC 20009). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 4: No. 6, 2870-2873(Nov 1986).

A mechanistic model of the tool wear process has been presented [B. M. Kramer and P. K. Judd, J. Vac. Sci. Technol. A 3, 2439 (1985)] that includes the effects of both the abrasion of the tool material by inclusions within the workpiece and the chemical dissolution of the tool material into the matrix of the workpiece. Machining tests have been run on steel with titanium carbide coated tooling and the resulting test data have been employed to produce a rough calibration of the proposed model. This model has been used to predict the wear resistances of the other group IV B carbides and of the (Ti,Hf)C system in the machining of steel.

8378 **Hot forging characteristics of fine-grained ZrO/sub 2/ and Al/sub 2/O/sub 3//ZrO/sub 2/ ceramics.** Kellett, B.J.; Lange, F.F. (Rockwell International Science Center, Thousand Oaks, CA 91360). *Journal of the American Ceramic Society;* 69: No. 8, C172-C173(Aug 1986).

Preliminary results indicate that large strains (>80%) and strain rates (0.001 s/sup -1/) can be obtained without tearing (or cracking) in fine-grain ZrO/sub 2/ (0.3 μm) and Al/sub 2/O/sub 3//ZrO/sub 2/ (1μm) ceramics. Aluminia develops crystallographic and morphological texture.

8379 **A simple model for the deformation behavior of tantalum carbide.** Hoffman, M.; Williams, W.S. (Loomis Lab. of Physics and Materials Research Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). *Journal of the American Ceramic Society;* 69: No. 8, 612-613(Aug 1986). Contract AC02-76ER01198.

The high-temperature hardness of tantalum carbide is linked to the presence of extended stacking faults. Suzuki hardening limited by carbon diffusion is presented as the mechanism which distinguishes tantalum carbide from other carbides with the same structure. Softening is predicted to occur at temperatures near those observed experimentally.

8380 **Crack branching as a mechanism of crushing during grinding.** Conway, J.C. Jr.; Kirchner, H.P. (Ceramic Finishing Co., State College, PA 16801). *Journal of the American Ceramic Society;* 69: No. 8, 603-607(Aug 1986).

A crushing model, based on a crack-branching mechanism of crushing, an elastic analysis of the stress distribution, and a critical stress intensity factor criterion for the extent of crack propagation, was used to estimate the extent of crushing under a diamond point subjected to an inclined load. The depths of the crushed region were compared with the groove depths formed in several materials during single-point grinding under similar loading conditions. Good agreement was observed between the absolute values of the groove depths and crushing depths, and the load dependence of these values for soda-lime glass. In the case of silicon nitride and silicon carbide, there was good agreement between the calculated and the experimental load dependencies but the absolute values of the experimentally determined groove depths were somewhat smaller than the calculated crushing depths.

3606 Other Materials

REFER ALSO TO CITATION(S) 7892, 7893, 7894, 8027, 8068, 8218, 8219, 8220, 8361, 8367, 8369, 8451, 8453, 8453, 8457, 8543, 8543, 8554, 8554, 8669, 8764, 8764

8381 **(BMI/ONWI—626) ERG [Engineering Review Group] review of the SRP [Salt Repository Project] salt irradiation effects program: Technical report.** Clark, D.E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1986. Contract AC02-83CH10140. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002845.

The Engineering Review Group (ERG) was established by the Office of Nuclear Waste Isolation (ONWI) to help evaluate engineering-related issues in the US Department of Energy's nuclear waste repository program. The August 1985 meeting of the ERG reviewed the Salt Repository Project (SRP) salt irradiation effects program. This report documents the ERG's comments and recommendations on these subjects and the ONWI response to the specific points raised by the ERG.

8382 **(CERN-EP—86-134) Diffusion of tellurium in silicon.** Stolwijk, N.A.; Rollert, F.; Gruenebaum, D.; Mehrer, H.; Weyer, G. (Muenster Univ. (Germany, F.R.). Inst. fuer Metallforschung; Aarhus Univ. (Denmark). Inst. of Physics). 22 Sep 1986. 7p. (CONF-860895—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900145.

From 14. international conference on defects in semiconductors; Paris, France (18 Aug 1986).

Diffusion of Te in Si was studied by a radiotracer techniques using ^{121}Te produced and on-line implanted at the ISOLDE facility at CERN and by spreading-resistance measurements after diffusion from the vapor phase. Penetration profiles of Gaussian type and of erfc-shape were found, respectively, corresponding to the actual boundary conditions. Diffusion coefficients from both experiments show an excellent agreement. Remarkable is the pronounced curvature observed in the Arrhenius diagram. Another striking feature of the present work is the occurrence of diffusion profiles with an exponential dependence on the penetration depth.

8383 **(CONF-870102—5) High temperature thermal conductivity of a carbon-bonded carbon fiber insulation.** Pawel, R.E.; Eatherly, W.P.; Robbins, J.M.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002419.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

The thermal conductivity of fibrous materials such as CBCF involves temperature dependent contributions from both the solid and gaseous constituents. At higher temperatures, radiative heat transfer also becomes important. Each of these contributions depends not only upon the volume fraction of the solid component, but will vary according to the morphological details. Steady-state techniques have provided accurate measurements to 1400°K, and these results can be used for purposes of comparison and to test heat flow models.

8384 **(DOE/CE/40702—3) Application of chemicals to substrates without the use of liquids: Solid-on-solid processing: Technical progress report 3, January 1, 1985-March 31, 1985.** Cook, F.L. (Georgia Inst. of Tech., Atlanta (USA). School of Textile Engineering). 24 Oct 1986. Contract FG05-84CE40702. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002427.

Candidates for pigment binder formulations were hot pressed into films on a Rocker PHI platen press. Aluminum foil was substituted for the metal shim material of the press surface to minimize binder/metal adhesion. The compositions of the screened materials are reported, and the platen press conditions and film results are reported. Attempts were also made to quantify the melting temperature and melt viscosity of the candidate resins. The melt viscosities were obtained by use of a Brookfield Model HBT viscometer (Spindle No. 298). The results are also included.

8385 **(DP-MS—86-116) Performance of special wasteform lysimeters and waste migration at a humid site.** McIntyre, P.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 11p. (CONF-860990—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002645.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The special wasteform lysimeter (SWL) program at the Savannah River Laboratory (SRL) near Aiken, South Carolina, is designed to measure leaching behavior and radionuclide migration under realistic burial conditions at a humid site. A similar program at an arid site is being conducted at Hanford near Richland, Washington. The wasteforms were placed in the lysimeters in March 1982 and represent typical low-level waste from two commercial

reactors. An extensive report covering the initial three years of operation was issued in November 1985. This report updates the results of that report and includes significant observations made during the past year of operation. The Waste Migration Program at SRL included continued monitoring of 40 defense waste lysimeters, radionuclide uptake by pine trees, and measurement of total organic carbon in the groundwater of the burial ground.

8386 **(DPST—85-615) Large Scale Leach Test Facility: Development of equipment and methods, and comparison to MCC-1 leach tests.** Pellarin, D.J.; Bickford, D.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 22 Jul 1985. Contract AC09-76SR00001. 44p. NTIS MF A01; 2; GPO Dep. File Number DE87002641.

This report describes the test equipment and methods, and documents the results of the first large-scale MCC-1 experiments in the Large Scale Leach Test Facility (LSLTF). Two experiments were performed using 1-ft-long samples sectioned from the middle of canister MS-11. The leachant used in the experiments was ultrapure deionized water - an aggressive and well characterized leachant providing high sensitivity for liquid sample analyses. All the original test plan objectives have been successfully met. Equipment and procedures have been developed for large-sample-size leach testing. The statistical reliability of the method has been determined, and "bench mark" data developed to relate small scale leach testing to full size waste forms. The facility is unique, and provides sampling reliability and flexibility not possible in smaller laboratory scale tests. Future use of this facility should simplify and accelerate the development of leaching models and repository specific data. The factor of less than 3 for leachability, corresponding to a 200,000/1 increase in sample volume, enhances the credibility of small scale test data which precedes this work, and supports the ability of the DWPF waste form to meet repository criteria.

8387 **(LBL—22082) Influence of the InAs-GaAs miscibility gap on the In/GaAs reaction.** Ding, J.; Washburn, J.; Sands, T.; Keramidas, V.G. (Lawrence Berkeley Lab., CA (USA); Bell Communications Research, Inc., Murray Hill, NJ (USA)). Aug 1986. Contract AC03-76SF00098. 8p. (CONF-8609150—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002542.

From International symposium on gallium arsenide and related compounds; Las Vegas, NV, USA (28 Sep 1986).

The In/GaAs reaction in the temperature range 350 to 650°C has been studied by analytical and high resolution electron microscopy and electron and x-ray diffraction. Histograms of the compositions of the In/sub 1-x/Ga/sub x/As precipitates formed during annealing confirm the existence of a miscibility gap in the InAs-GaAs pseudo-binary system. Implications of these results for the fabrication of graded layer In/sub 1-x/Ga/sub x/As/n-GaAs ohmic contacts by thermal reaction are discussed.

8388 **(N—86-29692) Review of methods for preparation of zinc and cadmium sulfide, selenide and telluride single cyrstals.** Kucharczyk, M.; Zabludowska, K. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1986. 28p. (NASA-TM—88426; NAS—1.15:88426). NTIS, PC A03/MF A01.

Translated from Matematy ka Fizyka, Chemia (Poland), No. 1, 3-21(1976).

The growth method of (Zn,Cd)S, (Zn,Cd)Se, (Zn,Cd)Te single crystals is reviewed. It is suggested that the method of sublimation-condensation is the most suitable to the conditions and facilities available, and should be employed in the Department of Physics of Bislystok Polytechnic.

8389 **(NTB—86-13) Swelling, permeability and shrinkage tests on quartz sand-bentonite mixtures.** Bucher, F.; Jedelhauser, P.; Mayer, P.-A. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1986. 39p. (In German). Nagra, Ch-5401 Baden, Switzerland.

In this report the results are presented of sweling, permeability and shrinkage tests on quartz sand-bentonite mixtures. The bentonites used were those previously investigated, i.e. the Na-bentonite MX-80 and the Ca-bentonite Montigel. The selected quartz sand exhibited a steep grading curve in the range 1 to 1.5 mm. The bentonite content was 35% and 45% respectively of the mass of the dry quartz sand. Measured swelling pressure are represented in function of the dry density of the bentonite included in the pores. The test results were in good agreement with those of the tests on pure bentonite. Measurements of the hydraulic conductivities of the studied quartz-bentonite mixtures gave average values in the range 2 to 3.10/sup -10/ m/s. These values are about 10/sup 4/ times higher than those measured on pure bentonites. Compared with pure bentonite the amounts of shrinkage measured on bentonite-quartz sand-mixtures are very low, especially on mixtures with Montigel. For the examined domain, the secondary shrinkage s/sup '/ of the compacted specimen can be calculated. Considering the measured shrinkage amounts we can assume that, with the chosen bentonite contents and the achieved dry densities, an intergranular contact between the sand grains has been reached. In the tests with previous free swelling in a humid room, the amounts of shrinkage are higher. In this case mixtures with Montigel gave higher values than those with MX-80.

8390 **(ORNL/TM—9879) Leachability studies of hydrofracture grouts.** Gilliam, T.M.; Loflin, J.A. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87002975.

Leaching studies were performed on simulated hydrofracture grouts containing As, Ba, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, ^{90}Sr, and ^{137}Cs. The grout samples were leached in three solutions: distilled water, shallow groundwater, and a deep brine. The resulting leach data are compared with the NRC and EPA regulatory requirements for the disposal of solid wastes.

8391 **(SAND—85-0865) Quality control of raw materials used for glass melting.** Wengert, P.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002087.

The glass-melting operation at Sandia National Laboratories supports glass and glass-ceramic applications requiring specific chemical and mechanical properties. The quality of thw raw materials used as sources of oxides in the glass melts is very important. After several years of operation, our stockroom contained over 100 raw materials of reagent grade quality. The stockpile provided an excellent opportunity to determine just how suitable these materials were for glass fabrication. Materials were analyzed by thermogravimetric analysis (TGA) and by x-ray diffraction (XRD); 34% were not what we thought they were. Errors included mislabeling, incorrect oxidation state, and H_2O and CO_2 contamination. As a result, quality control procedures have been revised to include specific incoming analysis and storage procedures. The presentation highlights the analytical findings and the revised quality control procedures.

8392 **(SAND—86-2037C) Buried insulator formation in silicon by ion implantation: A review.** Stein, H.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 20p. (CONF-861068—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002695.

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Dynamic annealing, impurity diffusion, chemical bonding and post-implantation annealing processes in the formation of silicon-on-insulator (SOI) materials by implantation of oxygen (SIMOX) and nitrogen (SIMNI) are reviewed. Implantation temperatures for SOI formation must be selected for dynamic annealing during implantation to retain crystallinity in a Si overlayer while maintaining implanted ion profiles in Si. These conditions are satisfied by temperatures near 500°C for beam currents and doses used in most studies for both SIMOX and SIMNI, and the implanted ions are chemically bonded into the Si host. SIMNI differs from SIMOX in two important ways: (i) in contrast to SIMOX where a high diffusivity of O in SiO_2 increases the oxide layer thickness when the O concentration exceeds that for SiO_2 during implantation, N diffusivity is low in both Si and in Si_3N_4 so that N can accumulate in excess of that for Si_3N_4, and (ii) the buried nitride layer crystallizes during post-implantation annealing near 1200°C where-

as the oxide layer remains amorphous. Effects of these differences on resultant SOI materials are considered. Information from recent studies on combined O and N implantations for SOI, and effects of annealing SIMOX and SIMNI at temperatures above 1200°C are included in the review. 50 refs., 13 figs.

8393 **(SAND—86-2163) Composite Bombcase Program: Static tests on Kevlar/epoxy and graphite/epoxy plates and rings.** Guess, T.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002751.

An experimental study supporting the Composite Bombcase Program is described. The purpose of the study was to generate mechanical properties and structural response data on composite plates and cylinders. This data base is now available to assist in the evaluation of composite materials for bombcase applications. Two composites, Kevlar 49/epoxy and IM6 graphite/epoxy, were chosen for testing. The mechanical properties from flat unidirectional specimens were used to predict the elastic response of thick quasi-isotropic laminates in four-point bending and the elastic response of 18.0 inch diameter quasi-isotropic rings to diametral compressive loading. Good agreement between theoretical and experimental values of elastic response was obtained for both geometries. Load-deflection and load-strain curves in the elastic, post-yield, and failure regions were obtained for composite and aluminum rings. Delamination between plies was the principal failure mode in the QI composite plate and ring specimens. Even with many delaminations at large deflections, composite rings continued to carry load and retain some structural integrity.

8394 **Origin of strength increase of abraded or indented glass upon annealing.** Tomozawa, M.; Hirao, K.; Bean, P.E. (Materials Engineering Dept. and Center for Glass Science Technology, Rensselaer Polytechnic Institute, Troy, NY 12180-3590). *Journal of the American Ceramic Society;* 69: No. 8, C186-C187(Aug 1986).

The mechanical strength of soda-lime and borosilicate glass rods with an extended crack was found to increase upon annealing. Since the residual stress near the extended crack tip is small, this strength increase indicates that crack tip blunting is taking place.

8395 **Manufacture of high purity metal fluorides.** Vance, J.M. (Oak Ridge Gaseous Diffusion Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). pp 453-456 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8411141—).

From Workshop on tungsten for VLSI applications; Albuquerque, NM, USA (12 Nov 1984).

A great deal has been said that about technology transfer since the Stevenson-Wydler Technology Innovation Law was enacted in 1980. This legislation stated that any federally funded laboratory with a budget in excess of $20 million annually must set aside 0.5% of its research and development (R&D) budget for the purpose of transferring technology. This legislation is intended to disseminate information so that the government expenditures for R&D will stretch further and private enterprise can be assisted in developing a competitive edge over foreign industry.

8396 **Fundamental mechanisms of CVD.** Breiland, W.G.; Coltrin, M.E.; Ho, P. (Div. 1126, Sandia National Labs., Albuquerque, NM 87185). pp 519-524 of Tungsten and other refractory metals for VLSI applications. Blewer, R.S. Pittsburgh, PA; Materials Research Society (1986). (CONF-8411141—).

From Workshop on tungsten for VLSI applications; Albuquerque, NM, USA (12 Nov 1984).

A program of coordinated experimental and theoretical research on the fundamental chemistry and physics of VCD is described. The experimental work involves the development and use of laser diagnostic techniques for monitoring chemical species in the gas phase and measuring fluid-flow properties. The theoretical work applies state-of-the-art computational techniques to the coupled fluid mechanical and gas-phase chemical kinetics of CVD. The work has concentrated on the simple model system of silicon deposition from silane, although the concepts should be applicable to CVD in general. Some preliminary work on the chlorosilane and tungsten hexafluoride systems is also described.

8397 **Upholstery textile performance following exposure to daylight.** Butler, S.; Guerin, D. (Dept. of Home Economics and Consumer Sciences, Miami Univ., Oxford, OH 45056). *Passive Solar Journal;* 3: No. 2, 179-190(1986).

This research investigated the effects of exposure to daylight on upholstery textiles. Eleven fabrics preferred by consumers were exposed to daylight in outdoor test cabinets for six months. Exposed and unexposed specimens were tested for tensile strength, elongation, abrasion resistance, and colorfastness. Statistical analysis indicated highly significant fabric/exposure interactive effects; significant losses in warp and filling strength, warp and filling elongation, and the resistance to abrasion in most of the exposed upholstery textiles tested. Color change was also found in the majority of exposed fabrics. Results indicate that careful selection of upholstery fabrics is required by energy-conscious consumers and designers.

8398 **Novel characterization of thin film multilayered structures: Microcleavage transmission electron microscopy.** Lepetre, Y.; Schuller, I.K.; Rasigni, G.; Rivoira, R.; Philip, R.; Dhez, P. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). pp 258-264 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Microcleavage Transmission Electron Microscopy has been applied to the study of many properties of multilayers samples. The authors illustrate the unique capabilities of this technique to study long range perpendicular thickness drifts, lateral variations, roughness, substrate quality and island structures.

8399 **Disorder and diffusion in thin-film multilayers.** Sarena, A.M. (Biology Dept., Brookhaven National Lab., Upton, NY 11973-5000). pp 168-173 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—). Contract AC02-76CH00016.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Practical multilayer devices usually have some in-built imperfections that adversely affect their properties. An analysis of the diffraction properties of a multilayer, and its comparison with the results obtained from a theoretical model of a multilayer with imperfections, can give information about the type and magnitude of imperfections in the multilayer. This information can then be used to make multilayers with better characteristics.

8400 **Image formation in multilayers optics: The Schwartzchild objective.** Lai, B.; Cerrina, F.; Underwood, J.H. (Dept. of Electrical and Computer Engineering, Univ. of Wisconsin, Madison, WI 53706). pp 174-181 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

The construction of efficient X-ray optics has been hampered in the past by the strong aberrations implicit in the use of grazing optics. This is in turn due to the necessity of working below the critical angle for total external reflection. For most materials this (grazing) angle falls in the range of a few degrees. The advent of Layered Synthetic Microstructures (LSM) has opened up new possibilities, as mirrors with high reflectivities at large incidence angles in the soft X-ray region, particularly below the Carbon edge, have been demonstrated. 1:1 imaging with LSM deposited on a curved Silicon substrate has been obtained. Designs based on two or more mirrors, in particular of the Schwartzschild objective type (SO), appear possible and have been already pro-

posed. The proposed use is in a scanning microscope mount, where the X-rays are brought to a fine focus on axis and the sample is scanned across it under computer control. The resulting image is a two dimensional map of either the transmission or of some secondary process. The SO are normally diffraction limited even at wavelengths as short as 50 Angstroms. The authors' discuss in detail some results and its effect on the image formation of the SO, as a test case. It appears that for the range of angles encountered in these objectives the influence of phase shifts is modest and should not degrade the image formation, while the non-uniform absorption on the primary may present serious problems in the case of high-power sources.

8401 **Synchrotron based measurements of the soft x-ray performance of thin film multilayer structures.** Kania, D.R.; Bartlett, R.J.; Trela, W.J. (Los Alamos National Lab., P.O. Box 1663, MS E526, Los Alamos, NM 87545). pp 216-220 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

There is a great interest in the application of thin film multilayer structures for x-ray optical elements. The authors have developed apparatus and techniques to measure the reflectivity of multilayer structures on flat substrates a function of energy at angles from grazing to near normal incidence using a synchrotron. They will present descriptions of measurement techniques and an apparatus along with a comparison between theoretical calculations and experimental data.

8402 **Multilayers on flexible mica.** Nagel, D.J.; Gilfrich, J.V.; Brown, D.B.; Barbee, T.W. Jr. (Naval Research Lab., Washington, DC 20375-5000). pp 326-327 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

X-Ray optics can be broadly classified as being either reflective or transmissive, with either broad or narrow band pass, configured to be either non-focusing or focusing. Multi-layers which reflect (diffract) soft x-rays with intermediate resolution, which can be elastically bent into either convex, non-focusing or concave, focusing geometries, are of interest in this work. Preparation and characteristics of the multilayers are described with the experimental details of the concave and convex geometries.

8403 **Image quality of figured multilayered optics.** Peterson, B.G.; Knight, L.V.; Pew, H.K. (Dept. of Physics & Astronomy, Brigham Young Univ., 296 Eyring Science Center, Provo, UT 84602). pp 328-340 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

The reflectivity and resolution of a multilayer structure is strongly affected by the roughness at the interfaces between two successive layers and by the amount that the constituent materials will diffuse into one another at the interfaces. Performance is also affected by the variations in individual layer thicknesses and by inhomogeneities in the materials. These deviations from the ideal multilayer will also affect the quality of the image from a figured multilayer optical element. The theory used to model the effects of non-ideal multilayers on the image quality of figured optics is discussed. The relationship between image quality and multilayer structure quality is illustrated with several examples.

8404 **Physical and chemical characterization of multilayered structures.** Thorne, J.M.; Knight, L.V.; Peterson, B.G. (Depts. of Chemistry and Physics, Brigham Young Univ., 218 ESC, Provo, UT 84602). pp 342-345 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

It is important to know the physical and chemical properties of a multilayer if its performance is to be compared to theoretical predictions, or if guidance is needed for the production of superior multilayers. Accurate, nondestructive analytical methods, such as neutron activation analysis, are restricted to certain elements. Certain destructive methods, such as total carbon analysis by combustion, can be sensitive enough for use with very small samples. The method of choice depends upon sensitivity and specifically, both of which are discussed in this paper.

40 CHEMISTRY

8405 **(UCID—20622-86-8) Synthesis project: Chemistry Research Resource monthly progress report, August 1986.** (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002388.

Summaries of progress in the following areas of chemistry and materials are presented: synthesis of new materials, development of analytical techniques, chemical kinetics and transport processes, artificial intelligence, development of techniques for characterization, materials modeling analysis, mechanical properties of polymers, physical metallurgy - phase transformations, surface modification and surface studies, and new materials development and properties. (PLG)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 7989

8406 **(CONF-8610149—4) Use of scientometrics to assess nuclear and other analytical methods.** Lyon, W.S. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001829.

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Scientometrics involves the use of quantitative methods to investigate science viewed as an information process. Scientometric studies can be useful in ascertaining which methods have been most employed for various analytical determinations as well as for predicting which methods will continue to be used in the immediate future and which appear to be losing favor with the analytical community. Published papers in the technical literature are the primary source materials for scientometric studies; statistical methods and computer techniques are the tools. Recent studies have included growth and trends in prompt nuclear analysis impact of research published in a technical journal, and institutional and national representation, speakers and topics at several IAEA conferences, at modern trends in activation analysis conferences, and at other nonnuclear oriented conferences. Attempts have also been made to predict future growth of various topics and techniques. 13 refs., 4 figs., 17 tabs.

8407 **(DOE/ER/13619—1) Resonance Raman and photophysical studies of polypyridine complexes of ruthenium: Progress report, Sept. 1, 1986-Feb. 28, 1987.** Kincaid, J.R. (Marquette Univ., Milwaukee, WI (USA). Dept. of Chemistry). 29 Oct 1986. Contract FG02-86ER13619. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002400.

In the seven weeks that the contract has been in effect, much of the equipment has been ordered. Although the main equipment item, a Nd:YAG laser has not yet been delivered, the design and construction of a suitable optical table is essentially complete.

The requested He:Cd laser has been delivered and spectra of several compounds of interest have been acquired. A relatively large amount of a precursor for the synthesis of many of the target compounds has been prepared. In addition adequate quantities of the ligand appropriate for the synthesis of one of the series complexes of immediate interest have been prepared.

8408 **(DOE/ER/60431—1) Field-flow fractionation in the analysis of energy-related materials. Progress report, April 1, 1986-March 31, 1987.** Giddings, J.C. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). Oct 1986. Contract FG02-86ER60431. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002094.

During the past year advances have been made in all areas of the proposed research. Split-outlet and reinjection procedures have been developed for basic particle characterization by sedimentation field-flow fraction (FFF). Steric FFF has been expanded to include a flow-induced field and new theory for elucidation of mechanism. Cyclical-field FFF has produced separations and accurate particle density data. The energy-related applications portion of the project has been particularly fruitful this year. We have obtained the molecular weight distributions of fulvic and humic acids using flow FFF and separation and size characterization of colloidal particles in river water by sedimentation FFF.

8409 **(MLM—3389) Mound activities in chemical and physical research: January-June 1986.** (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 10 Oct 1986. Contract AC04-76DP00053. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002348.

Several ion exchange column runs and batch two-phase equilibrium experiments were completed in the search for practical calcium isotope enrichment processes. A new experimental thermal diffusion column was constructed for measurement of thermal diffusion factors in the liquid phase. The column was tested with three isotopic systems: benzene, chlorobenzene, and ethyl chloride. The thermal diffusion factor for the C_6D_6/C_6H_6 pair was found to be 0.158; for the $C_6H_5\ ^{37}Cl/C_6H_5\ ^{35}Cl$ pair, 0.0243; and for the $C_2H_5\ ^{37}Cl/C_2H_5\ ^{35}Cl$ pair, 0.0317. With the exception of ethyl chloride, these results are in good agreement with earlier measurements. The new value for ethyl chloride is believed to be more reliable than the one reported earlier. Measurements have been made of the time dependence of the approach to the steady state in thermal diffusion experiments on the ^4He-^{20}Ne system. The steady state results provide a sensitive test of the validity of recently proposed potentials for the He/Ne, He/He, and Ne/Ne interactions. The possibility of determining plutonium concentrations by work measurements is presented. The graph of an hypothesized "work titration" is discussed. 22 refs.

8410 **(N—86-29026) Boron determination in steels by inductively-coupled plasma spectometry (ICP).** Coedo, A.G.; Lopez, M.T.D. Translated from *Revista de Metalurgia (Madrid) ;* **21**: No. 2, 87-90(Mar-Apr 1985). 14p. (NASA-TM—88434; NAS—1.15:88434). NTIS, PC A02/MF A01.

The sample is treated with 5N H_2SO_4 followed by concentrated HNO_3 and the diluted mixture is filtered. Soluble B is determined in the filtrate by inductively-coupled plasma (ICP) spectrometry after addition HCl and extraction of Fe with ethyl-ether. The residue is fused with Na_2CO_3 and, after treatment with HCl, the insoluble B is determined by ICP spectrometry as before. The method permits determination of ppm amounts of B in steel.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 7888, 7992, 7993, 8002, 8272, 8409, 8424, 8571

8411 **(AD-A—172059/8/XAB) Inverse deuterium isotope effect in the intersystem crossing of diphenylcarbene. Report for 1984-1985.** Langan, J.G.; Sitzmann, E.V.; Eisenthal, K.B. (Columbia Univ., New York (USA). Dept. of Chemistry). 7 Feb 1986. 5p. NTIS, PC A02/MF A01.

The singlet-to-triplet intersystem crossing rate k/sub ST/ of diphenylcarbene (DPC) is found to exhibit an inverse isotope effect in various solvents. An off-resonance coupling model between the initial singlet state and a sparse triplet vibronic manifold accounts for k/sub ST/ showing both an inverse isotope effect in a given solvent as well as an inverse energy gap effect in a solvent series.

8412 **(DOE/ER/45193—T3) Synthesis and properties of novel electroactive organometallic polymers: Annual progress report, 12/1/85-11/1/86.** Rosenblum, M. (Brandeis Univ., Waltham, MA (USA). Dept. of Chemistry). 4 Nov 1986. Contract FG02-85ER45193. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002361.

Since the report submitted last year, the crystal structure of 1,8-diruthenocenylnaphthalene has been refined and is now completed. The structure of this compound is very close to that of the iron analog. In particular, the dihedral angle between the cyclopentadienyl and naphthalene rings, as well as the splaying angle of the cyclopentadienyl rings in these compounds are very similar. These data provide substantial evidence for the conclusion that the large cyclopentadienyl rotational angle of 45° observed for the Fe analog is not the consequence of nonbonded steric interactions between hydrogens on the unsubstituted cyclopentadienyl ring and the β-hydrogen of the naphthalene ring.

8413 **(IS-T—1179-01/86) New reduced ternary molybdenum oxide with infinite Mo-Mo bonded chains.** Carlson, C.D. (Ames Lab., IA (USA)). Jan 1986. Contract W-7405-ENG-82. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86016017.

A novel reduced ternary oxide of molybdenum is reported. The phase contains infinite octahedral chains of bonded molybdenum atoms with an average oxidation state of 2.375. The pure material can be obtained using stoichiometric quantities of manganese molybdate, molybdenum trioxide, and molybdenum powder. The structure of the crystal was solved and consists of molybdenum oxide chains extending parallel to the c-axis with interconnection by various geometries of oxygen: including square planar, trigonal planar, and sawhorse. The molybdenum oxygen framework forms trigonal prismatic tunnels in which the ternary cations reside. Studies of the electrical and magnetic properties show that the title compound is a metallic conductor and a paramagnet with weak antiferromagnetic coupling. Ion exchange reactions on Mn/sub 1.5/ Mo_8O_{11} with various molten metal chloride salts are also presented. 26 refs., 8 figs., 10 tabs.

8414 **(K/OA—5904) Liquid-phase compositions from vapor-phase analyses: 3, Reanalysis of HF vapor-densities and of UF_6-HF liquid-vapor equilibria.** Davis, W. Jr.; Cochran, H.D. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1986. Contract AC05-84OT21400. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87000122.

Currently, liquid-phase samples from uranium hexafluoride (UF_6) cylinders are used by all US Department of Energy enrichment facilities for determining the chemical content of cylinders - a requisite in the control and accountability of nuclear materials. Previously published reports note the economic incentive to use vapor-phase sampling for volatile impurities if the liquid-phase composition can be determined from analysis of vapor-phase composition can be determined from analysis of vapor-phase samples by use of a model of vapor-liquid equilibrium for UF_6 and its common impurities. Such a model was adapted for this purpose in earlier work. This report describes efforts to improve the modeling of vapor-phase hydrogen fluoride (HF), one of the common impurities of UF_6. 22 refs., 3 figs., 6 tabs.

8415 **(LBL—22249) Hydrocarbon interactions with Ir, Ni, Si, and $NiSi_2$ surfaces.** Klarup, D.G. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Chemistry). Oct 1986. Contract AC03-76SF00098. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002578.

Thermal desorption spectroscopy was used to investigate interactions of organic adsorbate molecules on Ir(111), Ni(111), Ni(100), Si(111), Si(111), $NiSi_2$(111), and $NiSi_2$(100) surfaces. The decomposition of methyl-substituted benzenes was studied on Ir(111), Ni(111), and Ni(100), and the adsorption of acetylene, eth-

ylene, benzene, and pyridine was studied on Si(111), Si(100), $NiSi_2$(111), and $NiSi_2$(100). The growth mechanism of $NiSi_2$ on Si was investigated as well. Factors such as adsorbate symmetry, surface geometry, and sub-surface composition are used to interpret the thermal desorption results. 137 refs., 21 figs., 3 tabs.

8416 **C-C bond cleavage in hydrocarbons by iridium complexes.** Crabtree, R.H.; Dion, R.P.; Gibboni, D.J.; McGrath, D.V.; Holt, E.M. (Yale Univ., New Haven, CT). *Journal of the American Chemical Society;* **108**: No. 23, 7222-7227(12 Nov 1986).

A variety of transformations involving C-C bond cleavage in iridium complexes is described. 1,1-Dimethylcyclopentane reacts with $[IrH_3(Me_2CO)_2L_2]SbF_6$ (L = (p-FC_6H_4)$_3$P, 1) to give first $[(5,5\text{-}C_6H_4Me_2)IrL_2]SbF_6$ (2) and then $[(MeC_6H_4)IrMeL_2]SbF_6$ (3). The corresponding 5,5-dimethylcyclopentadiene gives 1,2- and 1,3-diethylcyclopentadienyl complexes by a route that involves alkyl migration from ring to metal and back. 4,4-Dimethylcyclopentene also reacts to give 3 but the 3,3-isomer follows a different path to give $[(MeC_6H_4)IrHL_2]SbF_6$. Crystal structures of two diene complexes of type 2 are reported and mechanisms for the reactions observed are proposed.

8417 **Isomerization of the hydridoalkylrhodium complexes formed on oxidative addition of rhodium to alkane C-H bonds. Evidence for the intermediacy of eta^2-alkane complexes.** Periana, R.A.; Bergman, R.G. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **108**: No. 23, 7332-7346(12 Nov 1986). Contract AC03-76SF00098.

The products of insertion of the coordinatively unsaturated fragment Cp*RhL (Cp* = eta^5-C_5Me_5; L = PMe_3) into alkane C-H bonds are generated by irradiation of Cp*(L)RhH_2 or thermal decomposition of Cp*(L)Rh(neopentyl)(H), at temperatures below -30°C in alkane solvents. The hydridoalkylrhodium products can be synthesized independently, also at low temperature, from the corresponding haloalkyl complexes by lithiation with t-BuLi followed by protonation. Alternatively, the highly nucleophilic complex Li[Cp*(L)RhH], prepared by deprotonation of Cp*(L)RhH_2, leads the alkylhydridorhodium complexes upon treatment with alkyl tosylates R-OTs. When Cp*RhL is generated in mixtures of linear alkanes, only the products of insertion into primary C-H bonds are observed, even at -100°C. The relative rate constants for the formation of these products correlate directly with the number of secondary C-H bonds in the alkane. This suggests that insertion occurs initially into all the C-H bonds of the alkane, but that even at very low temperatures the secondary insertion products rearrange quickly, and intramolecularly, to the primary products. The authors suggests that this rearrangement occurs through the intermediacy of eta^2-C-H alkane complexes. Further studies provide support for this idea. The synthetic procedures summarized above can be used to prepare regiospecifically ^2H and ^{13}C labeled alkyl hydrides at low temperatures. Warming these complexes to temperatures above -80°C in aromatic solvent reveals rearrangements which confirms that the alkylhydridorhodium complexes are capable of interconverting with one another intramolecularly at rates competitive with or in some cases faster than they undergo reductive elimination.

8418 **C-C activation of organic small ring compounds by rearrangement of cycloalkylhydridorhodium complexes to rhodacycloalkanes. Synthesis of metallacyclobutanes, including one with a tertiary M-C bond, by nucleophilic addition to π-allyl complexes.** Periana, R.A.; Bergman, R.G. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **108**: No. 23, 7346-7355(12 Nov 1986). contract AC03-76SF00098.

In the initial work on C-H activation by the unsaturated fragment [(eta^5-C_5Me_5)Rh(PMe_3)] the authors observed, as in the case of the iridium analogue, that generation of this fragment in cyclopropane at -60°C resulted only in C-H insertion to give a cyclopropyl hydride 1. Subsequently however, they communicated the observation that 1 rearranges by an intramolecular pathway to the rhodacyclobutane 4 in high yield. This observation presented a unique opportunity to study the direct rearrangement of the initial product of C-H activation, an alkyl hydride, to the C-C insertion product. The following describes, a mechanistic study of the rearrangement of 1 to 4 and the limited success in extending the chemistry to cyclobutane. Additionally some related chemistry on the independent synthesis of rhodacyclobutanes is reported.

8419 **Apparatus for adjusting and maintaining the humidity of gas at a constant value within a closed system.** Abernathy, B.R.; Walters, R.R. (to Dept. of Energy, Washington, DC). US Patent 4,622,049. 11 Nov 1986. Filed date 5 Aug 1985. v.p.

A device is described for maintaining and controlling the humidity of a gas within a sealed environment. The device comprises container means having a partition for separating the interior of the container means into upper and lower chambers. The lower chamber contains an aqueous saturated salt solution containing crystals of the salt. The device also comprises a tube extending through the partition plate to provide communication between the upper and lower chambers and to enable gas humidified by the salt solution within the lower chamber to pass into the upper chamber. The device further includes means for preventing salt from the salt solution from migrating to the upper chamber from the lower chamber, the salt migration preventing means being located within the tube.

8420 **Thermodynamics of complexation of lanthanides by dicarboxylate ligands.** Choppin, G.R.; Dadgar, A.; Rizkalla, E.N. (Florida State Univ., Tallahassee). *Inorganic Chemistry;* **25**: No. 20, 3581-3584(24 Sep 1986).

Thermodynamic parameters of complexation of lanthanide cations by succinate, glutarate, adipate, and trans-1,4-cyclohexanedicarboxylate (CHDCA) ligands have been measured with potentiometric and calorimetric techniques. When analogous data for oxalate and malonate complexing are included, the complex stability decreases sharply as the ring size increases from 5 to 7; however, for 7-9-membered rings, there is little difference in stability. The negative entropy contribution associated with expansion in ring size has been attributed to an increasing loss in the configuration entropy in the alkyl chain. The more positive entropy for the Sm-CHDCA complex compared to that of Sm-adipate is attributed to the favorable boat configuration for chelation with CHDCA.

8421 **Synthesis and x-ray crystal structure of bis(pentamethylcyclopentadienyl) lanthanide and yttrium halide complexes.** Evans, W.J.; Grate, J.W.; Levan, K.R.; Bloom, I.; Peterson, T.T.; Doedens, R.J.; Zhang, H.; Atwood, J.L. (Univ. of California, Irvine). *Inorganic Chemistry;* **25**: No. 20, 3614-3619(24 Sep 1986).

The synthesis and crystal and molecular structures of $(C_5Me_5)_2YCl(THF)$ (I), $(C_5Me_5)_2SmCl(THF)$ (II), and $(C_5Me_5)_2SmI(THF)$ (III) are described. $(C_5Me_5)_2YCl(THF)$ was isolated as a byproduct of the reaction of YCl_3 with KC_5Me_5. It crystallizes from THF/pentane at -20°C in space group P1 with unit cell dimensions a = 8.541 (2) A, b = 17.216 (6) A, c = 18.356 (6) A, α = 63.04 (2)°, β = 88.83 (2)°, γ = 88.36 (2)°, V = 2404.7 A^3, and D/sub calcd/ = 1.21 g cm^{-3} for Z = 4. $(C_5Me_5)_2SmCl(THF)$ was prepared by oxidation of $(C_5Me_5)_2Sm(THF)_2$ with t-C_4H_9Cl. It crystallizes from toluene at -30°C in space group P1 with unit cell dimensions a = 8.567 (5) A, b = 17.331 (6) A, c = 18.515 (6) A, α = 62.71 (3)°, β = 88.46 (4)°, γ = 87.82 (4)°, V = 2441.3 A^3, and D/sub calcd/ = 1.44 g cm^{-3} for Z = 4. $(C_5Me_5)_2SmI(THF)$ was prepared from $(C_5Me_5)Sm(THF)_2$ by oxidation with ICH_2CH_2I and from $[(C_5Me_5)_2SmH]_2$ by reaction with CH_3I. It crystallizes from toluene at 25°C in space group P1 with unit cell dimensions a = 8.812 (4) A, b = 17.569 (7) A, c = 18.464 (7) A, α = 62.25 (4)°, β = 89.16 (4)°, γ = 87.68 (4)°, V = 2625 A^3, and D/sub calcd/ = 1.63 g cm^{-3} for Z = 4. In each complex, the C_5Me_5 ring centroids, the THF oxygen atom, and the halide ligand describe a distorted tetrahedral geometry around the metal. The synthesis of $(C_5Me_5)_2SmCl_2Li(THF)_2$ and $(C_5Me_4Et)_2SmCl_2Li(THF)_2$ is also described.

8422 **Densities and apparent molar volumes of aqueous magnesium sulfate and sodium sulfate to 473 K and 100 bar.** Phutela, R.C.; Pitzer, K.S. (Dept. of Chemistry and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *Journal of Chemical and Engineering Data;* **31**: No. 3, 320-326(Jul 1986).

Densities of aqueous solutions of MgSO/sub 4/ and Na/sub 2/SO/sub 4/ have been measured up to 473 K, 100 bar, and 1 m ionic strength. The derived apparent molar volumes along with the available literature data on these substances have been analyzed by using the ion-interaction (Pitzer) approach. V-bar/sub 2//sup 0/ for MgSO/sub 4/ is obtained indirectly from values for MgCl/sub 2/, Na/sub 2/SO/sub 4/, and NaCl. The term in β/sup (2)/ represents adequately the ion-association effect in MgSO/sub 4/ up to 473 K. The present results yield the pressure effect on various thermodynamic properties.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 8045

8423 Measuring oxygen diffusion coefficients in electrolyte solutions with polarographic oxygen electrodes. Ju, L.K.; Livio, E.; Ho, C.S. (State Univ. of New York, Buffalo, NY 14260). pp 347-361 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Oxygen diffusion coefficients in various single and mixed electrolyte solutions were measured by using a membrane-covered dissolved oxygen electrode. It is observed that a linear relation between oxygen diffusion coefficients and the square root of total ionic strength applies well to both single and mixed electrolyte solutions, that is, $D = D_0(1 - f\sqrt{I})$. The values of f-factor for electrolyte solutions are found to be a function of a characteristic group (M/α). The oxygen diffusion coefficient as estimated from the suggested approach generally yields a smaller than +-3% deviation from experimentally determined values for electrolyte solutions having similar ionic strengths to normal fermentation media. 24 refs., 6 figs., 2 tabs.

4005 Photochemistry

8424 (CONF-860808—9) EPR evidence that the photosystem I acceptor A_1 is a quinone molecule. Thurnauer, M.C.; Gast, P.; Petersen, J.; Stehlik, D. (Argonne National Lab., IL (USA). Chemistry Div.; Chicago Univ., IL (USA). Dept. of Chemistry; Freie Univ., Berlin (Germany, F.R.). Abt. die Physik). 1986. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001487.

From 7. international congress on photosynthesis; Providence, RI, USA (10 Aug 1986).

It is believed that the electron spin polarized (ESP) EPR transients observed around g = 2 in plant photosystem I (PSI) are due to the radical pair $P+_{700}A^-_1$, the oxidized primary electron donor and reduced A_1 acceptor. In order to identify the nature of A_1 and test proposals that A_1 is a quinone molecule (1,2,3), the low temperature ESP EPR spectrum of $P+_{700}A_{-1}$ is investigated with fast time resolved EPR at K-band (~24 GHz) microwave frequency. The X-band (~10 GHz) ESP EPR signal in PSI has similar spectral characteristics as the ESP EPR signal due to the oxidized donor and reduced quinone acceptor ($P+_{870}Q^-$) observed in bacterial reaction centers (RC's) in which the iron is uncoupled from Q (4,5). This is true also at K-band frequency. Thus, thr RC's provide a relatively defined system with which we can test our methods of simulation of a quinone radical showing g-anisotropy and ESP which we then apply to the PSI ESP EPR signal. Simulations of A_{-1} based on these comparisons provide strong evidence that it is a quinone species. Furthermore, the anisotropic polarization observed for A_{-1} in ^2H PSI particles should allow us to place some limits on the mechanism responsible for the ESP. 11 refs., 4 figs.

8425 (DOE/ER/06034—T8) Energy conversion processes based on molecular excited states: Progress report, August 1, 1985-July 31, 1986. Meyer, T.J. (North Carolina Univ., Chapel Hill (USA)). Jan 1986. Contract AS05-78ER06034. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002499.

The major thrust of our DOE-supported research efforts remains the use of molecular excited states in energy conversion processes. In the past year we have made significant progress in four distinct areas: (1) photochemistry and photophysics of metal-to-ligand charge transfer excited states; (2) medium effects on excited state properties; (3) photoeffects in thin polymeric films; and (4) photochemistry of metal-metal bonds. 15 refs.

4007 Radiochemistry And Nuclear Chemistry

8426 (UCRL—94164-Rev.2) Application of atomic vapor laser isotope separation to the enrichment of mercury. Crane, J.; Erbert, G.; Paisner, J.; Chen, H.; Chiba, Z.; Beeler, R.; Combs, R.; Mostek, S. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 11p. (CONF-8609132—7-Rev.2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001363.

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Workers at GTE/Sylvania have shown that the efficiency of fluorescent lighting may be markedly improved using mercury that has been enriched in the ^{196}Hg isotope. A 5% improvement in the efficiency of fluorescent lighting in the United States could provide a savings of $450 million dollars in the corresponding reduction of electrical power consumption. We discuss the results of recent work done at our laboratory to develop a process for enriching mercury. The discussion centers around the results of spectroscopic measurements of excited-state lifetimes, photoionization cross sections, and isotope shifts.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

8427 (AD-A—172522/5/XAB) Investigation of fuel-additive effects on sooting flames. Final report, 1 May 1983-31 May 1986. Bonczyk, P.A. (United Technologies Research Center, East Hartford, CT (USA)). 31 Jul 1986. 126p. (UTRC/R—86-956545-F). NTIS, PC A07/MF A01.

Measurements were limited to well-defined hydrocarbon/air gaseous- and prevaporized liquid-fueled diffusion flames. Emphasis was given to alkaline-earth salt additives in an ethylene/air flame, as well as to ferrocene in a flame fueled by a prevaporized toluene/isooctane mixture. Nonperturbing laser/optical diagnostic techniques were used to measure flame temperature, as well as to relate changes in soot particulate size, number density, and volume fraction to additive type and concentration. For the ethylene flame, additive effectiveness was shown to vary from point-to-point in the flame and to maximize in the direction of increasing flame temperature. From the latter, and measured concentrations of metal combustion species, MOH+ (M = Ba, Sr, etc.) were concluded to be the particular species critical to soot suppression. The data indicate additive intervention at both early and late stages of soot formation, but it was not possible to conclude early intervention firmly. For the alkaline earths, an experiment complementary to the foregoing was conducted to test an often-quoted hypothesis of soot suppression in which metal-induced increases in OH concentration are presumed to enhance soot oxidation and removal. This was found, however, not to be valid. The effect of the alkaline earths on OH was to decrease the concentration of the latter radical at all points in the ethylene/air flame, which fundamentally is not supportive of the preceding hypothesis. For the toluene flame, ferrocene was observed to suppress a visible soot plume completely. Mie-scattering measurements at a late combustion stage demonstrated that suppression results almost entirely from particular number-density reduction.

8428 (ANL—86-41) Dynamic behavior of reacting gas jets submerged in liquids: a photographic study. Annual report, May 1, 1985-May 1, 1986. Cho, D.H.; Armstrong, D.R.; Bova, L. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002159.

A photographic study of a hydrogen chloride gas jet reacting in an aqueous solution of ammonia was conducted. The high-

speed motion pictures taken revealed that the behavior of the reacting gas jet was highly dynamic and complex. The gaseous jet penetration ("plume") was not stationary, but underwent a change in shape and size with time, which appeared to be periodic or cyclic. Certain observations made, including a high-pitched sound, exhibited a striking similarity to the so-called "singing flame" phenomenon. Such dynamic plume behavior is attributed to the vaporization of the bath liquid due to reaction heat release. The plume length measurements for large concentratins of ammonia seem to confirm the prediction that when the extent of vaporization is large, the plume length is mainly determined by the distance required for condensation of the vapor. 14 refs., 12 figs.

8429 **(DOE/ER/13503—1) Comprehensive mechanisms for combustion chemistry. An experimental and numerical study with emphasis on applied sensitivity analysis. Progress report, 15 March-10 September 1986.** Dryer, F.L. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 15 Sep 1986. Contract FG02-86ER13503. 34p. NTIS, PC A03. File Number DE87001757.

Study of the perturbation of the $CO/H_2/O_2$ reaction system by the addition of small amounts of another reactant has been continued to obtain elementary reaction data as well as mechanistic insights. Analysis of perturbations of the reaction by the additions of ethylene and acetylene (using both species flux and sensitivity gradient analysis techniques) are currently under study. Equipment for producing formaldehyde monomer and for selectively detecting formaldehyde in the presence of its pyrolysis and oxidation products has been developed and tested, and initial experiments on the pyrolysis and oxidation have been conducted in the flow reactor. Flow reactor experiments on the oxidations of methanol, ethanol, n-propanol, iso-propanol, and tertiary butyl alcohol have been further analyzed to develop a general phenomenological mechanism for the oxidation of simple alcohols. Significant progress has been made on developing a laser diagnostic facility which may be used to measure [OH] in the flow reactor. 34 refs., 9 figs.

8430 **(N—86-29011) Combustion theory for liquids with a free surface. 3: special problems.** Milkov, S.N.; Sukhov, G.S.; Yarin, L.P. Translated from *Fizika Goreniya i Vzryva ;* No. 3, 3-8(1985). 15p. (NASA-TM—88459; NAS—1.15:88459). NTIS, PC A02/MF A01.

Two special problems concerning the combustion of liquids with a free surface, i.e., flame quenching during the mixing of a burning liquid inside a container and liquid burnout from a porous layer, are analyzed using a quasi-one-dimensional model. The critical parameters corresponding to the quenching of a burning fluid with a free surface are determined. Determinations are also made of the limiting pressure gradients corresponding to the transition from the combustion mode where the liquid evaporates from the surface of a porous layer to the mode where the phase transition surface lies inside the porous layer.

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8431 **(SAND—86-2179C) Survey of diagnostic tools used in hypervelocity impact studies.** Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 16p. (CONF-861091—10). NTIS, PC A02. File Number DE87002496.

From Hypervelocity impact symposium; San Antonio, TX, USA (21 Oct 1986).

This paper surveys a variety of diagnostic tools that are available for use in studies of hypervelocity impact. Emphasis is on time-resolved methods for measuring pressure or particle velocity histories of stress waves induced under these conditions, and on the new developments of the past decade.

8432 **(UCID—20913) A brief study of complex viscous damping.** Pastrnak, J.W.; Hurty, W.C. (Lawrence Livermore National Lab., CA (USA)). 28 Oct 1986. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002750.

In the study of the vibration response of structures damping is often ignored since in many cases it is small. There are cases, however, in which it cannot be ignored and a better understanding of the damped response is necessary. The present study is directed toward structures in which damper devices are deliberately installed in order to control and reduce vibrations. In these systems vibration response will be characterized by complex eigenvalues and eigenvectors. This response has been called non-proportional damping in contrast to proportional damping in which eigenvalues and vectors are real. Interpreted physically, this means that damped vibration modes are the same as the undamped modes in the latter case, whereas, they are quite different in the former case.

8433 **(UCID—20918) Investigation of selected topics in structural control technology.** Lu, S.C.; Bumpus, S.E.; Wang, S.H. (Lawrence Livermore National Lab., CA (USA)). 30 Oct 1986. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002737.

This report summarizes results of an integrated structure-control research project in three areas: integrated simulation, modeling technique, and decentralized control design. We developed a computer simulation procedure and demonstrated its applicability to the evaluation of controller design by a couple of examples. We developed a computer code for the extraction of Lanczos modes. We applied the Lanczos transformation to the solution of classical real and complex eigenvalues and eigenvectors which are commonly used in the normal mode model reduction method. We derived a theory to adopt Lanczos coordinates as generalized coordinates in the component mode synthesis technique as an effective modeling scheme for complex structural systems. The theory was illustrated by a simple two-component structural system. Finally, we developed a powerful algorithm and demonstrated its application by an example for controller design based on an optimal decentralized control theory. For future research, we plan to focus on improvements in all three research areas to enhance the applicability of the results to large scale structural systems.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 7917, 7950, 8125, 8141, 8151, 8151, 8217, 8500, 8501

8434 **(BDX—613-3614) A generic specification for an electric drive industrial robot: Topical report.** Darner, G.S. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Nov 1986. Contract AC04-76DP00613. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002748.

Individual equipment specifications for electric drive industrial robot systems contain a significant common core of requirements. The creation of the specification for procurement of a robot typically has required review of several previous robot specifications to assure adequate definition of the system. Additionally, each specification is subjected to an intense review by several internal organizations at Allied Corporation, Bendix Kansas City Division (BKC), to assure compliance to requirements desired by that organization. Variations from specification to specification have complicated that review process. A generic specification to define the common requirements for procurement of an electric drive robot has been developed. The specification provides the nominal core of requirements desired on all future electric drive robots to be applied at BKC. This specification will be maintained in a computer word processing file so that the authors of robot specifications can readily complete the specific requirements for a particular robot application adding any additional requirements as needed.

8435 **(CONF-861081—2) A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences.** Kammer, D.W.; de Saussure, G.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002411.

From Workshop on automation and robotics for military applications; Huntsville, AL, USA (22 Oct 1986).

The use of an expert system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explanation, verification and modification of the rules which determine the robot's behavior, and the domain of competence can be incremen-

tally extended. However, real-time operation poses a number of challenges due to the dynamic nature of the data and the time constraints of dealing with a large data base. An implementation is discussed where a large commercial real-time expert system originally designed for industrial process diagnostics was adapted to the control of an autonomous mobile robot for planning, monitoring, and diagnosis of unexpected occurrences during a navigation task. Control has been successfully implemented for goal directed navigation in the presence of moving obstacles.

8436 **(ECN—85-192) Calculation of the residual axial stress in multifilament superconductive wire of the ECN-type.** Lijbrink, E. (Netherlands Energy Research Foundation, Petten). Dec 1985. 30p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A calculation method is presented to predict the residual stress in ECN-type wire used for superconductive purposes. The components of the wire are Nb/sub 3/Sn-filaments in a copper matrix. For the calculation are needed data with respect to the cross section, dimensions and composition, of the wire together with mechanical properties and thermal shrinkage data of the used materials: Cu, Nb and Nb/sub 3/Sn. 7 figs., 1 tab., 6 refs.

8437 **(ECN—85-194) Transient heat transfer to a forced flow of supercritical helium at 4.2 K.** Bloem, W.B. (Netherlands Energy Research Foundation, Petten). Jan 1986. 42p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The transient heat transfer coefficientn of supercritical helium flowing through a rectangular copper tube with a hydraulic diameter of 5 mm has been measured. The conditions of the flow were: inlet bulk temperature of the fluid 4.2 K, pressures from 3 bar to 10 bar and Reynolds numbers between 1.5 x 10/sup 4/ and 2 x 10/sup 5/. The tube was heated on four sides with heat fluxes up to 9800 W/m/sup 2/. From the experiments it followed that during the first tens of milliseconds the heat transfer is determined by the heat conduction in the laminar sublayer of the supercritical helium flow. The heat transfer coefficient is described. Although the helium properties are a strong function of pressure and temperature, it was remarkable that the temperature increase during a heat pulse was nearly the same at different flow pressures. After analysing the data an empirical relation h = b m/sup 0.75/ (t/sub t//t)/sup 1/n/ was derived, which predicts the heat transfer coefficient at a given mass flow m within 10 per cent during 0.1 s. The constants b, n and t/sub t/ are related to the mass flow m and the pressure of the fluid. 12 figs., 4 tabs., 19 refs.

8438 **(ESDU—5042) Effectiveness-N sub TU relationships for the design and performance evaluation of two-stream heat exchangers.** (Engineering Sciences Data Unit Ltd., London (UK)). Dec 1985. 57p. ESDU.

Data item ESDU 85042, Heat Transfer Sub-Series, gives equations and a large number of curves derived from them to allow design or performance evaluation of shell-and-tube heat exchangers. The curves cover co-current and countercurrent flow and various numbers of shells and of tube side passes. Also shown on the curves are the locus of designs for which a temperature cross may occur and the locus or 95 percent heat transfer effectiveness which indicates the region of uneconomic design. The method assumes a linear temperature/enthalpy relationship (constant specific heat capacity) for both streams. It applies to boiling or condensing flow of a single component with no temperature change, or boiling and condensing flow of a mixture that is always two phase. It excludes conditions in which transition from single to two-phase flow occurs. Worked examples show the application of the method.

8439 (IAEA-TECDOC—375, pp 35-45) **CANDU irradiated fuel transportation: The shock and vibration program.** Dalziel, B.P.; Elbestawi, M.A.; Forest, J.W. (Ontario Hydro, Toronto, Canada). May 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87700224.

In International studies on certain aspects of the safe transport of radioactive materials, 1980-1985. Report of the co-ordinated research programme on safe transport of radioactive materials.

This activity, which spanned a period from 1975 to 1984, was undertaken with the primary objective of evaluating the response of irradiated CANDU fuel to the shock and vibration transportation environment. Concurrently, data from field tests of road and rail transport systems similar to those which might be used for transporting irradiated fuel casks were obtained. These data provide guidance on transient and steady-state acceleration levels and power spectral densities which can be used to guide design and testing efforts relating to large cask systems. For the field tests, a 32 tonne mass containing a simulated spent fuel module was placed on a tractor/trailer system having a combined, unloaded mass of 18 tonne; and a similar 68 tonne mass was placed on a flat rail car of 28.9 tonne. Vertical components of acceleration were measured at the baseplate on which the mass was mounted and on the central module tube. For steady-state transport, maximum measured accelerations at the baseplate were 0.18 g for road and 0.20 g for rail; whereas, on the module tube the maximum values were 0.45 g for road and 0.30 g for rail. Power spectral densities showed most steady-state vibration energy is in the 0 to 300 Hz range for road and in the 0 to 500 Hz range for rail. Transient environments, such as a truck crossing railway tracks and, for railcars, the take-up of coupler slack or the crossing of switches produces amplifications in these values by factors of 1.1 to 3.4 for road transport and by as much as a factor of 10 for rail transport. The CANDU fuel bundles were found to be highly resistant to impact shocks. This study provided data for guiding system design. 9 refs, 6 figs, 5 tabs.

8440 (IAEA-TECDOC—375, pp 61-73) **Model investigations of the heat transfer in dry spent fuel casks.** Nitsche, F. (VEB Kernkraftwerk Bruno Leuschner, Greifswald, German Democratic Republic). May 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87700224.

In International studies on certain aspects of the safe transport of radioactive materials, 1980-1985. Report of the co-ordinated research programme on safe transport of radioactive materials.

For the investigation of the heat transfer within dry spent fuel casks model experiments were performed in which the spent fuel assemblies (SFA) and spent fuel elements (SFE) were simulated by electrically heated rods. The maximum heater surface temperatures were measured in dependence on various parameters and compared with calculations. The model experiments were performed in 2 stages: (1) Investigation of the heat transfer from 30 SFAs to the inner cask wall using a model arrangement of 30 heating rods in a model cask at a scale of 1:8. (2) Investigation of the heat transfer within a SFA using a SFA model of a pressurized-water type reactor with 90 heating rods. The results obtained in the first stage are represented in the Report SAAS-306 (Berlin, 1983). They allowed the maximum SFA surface temperature to be determined and led to a better qualitative in-sight in the heat transfer processes in vertical and horizontal cask position, to a more precise evaluation of internal temperatures measurable in the original cask and to a quantitative description of the radiant heat transfer between the SFAs and the cask wall. In the present second stage the temperature distribution of the SFA model is measured for different heat rates, in free air environment, in the model cask under vacuum and also under normal pressure and overpressure with different cooling gases (air, argon, helium). In free air environment roughly the same maximum heater surface temperatures were measured in horizontal and vertical SFA positions. Based on the measurements under vacuum a computer programme is validated and a simplified analytical representation is derived for calculating the radiant heat transfer in the SFA. 8 refs, 16 figs.

8441 **(K/PS—5068) Thermal analysis of UF_6 cylinder inside a protective overpack.** Park, S.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Nov 1986. Contract AC05-84OT21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002593.

To ensure their safety, cylinders containing reactor grade UF_6 are transported in protective overpacks. An overpack is designed to protect the UF_6 cylinder in a fire at least 1/2 h in case of an accident. A thermal analysis was performed on a 30-in.-dia cylinder in a protective overpack to simulate various accident cases and compared with available experimental data. The analysis included the thermal performance of both a damaged and an undamaged overpack as well as the effect of moisture in the insulating layer of an overpack. The results indicate that an average cylinder surface temperature inside an overpack, after exposure to a fire for 1 h, is

still below the level where appreciable UF_6 phase change would occur that could cause a cylinder to rupture.

8442 (NBSIR—86-3044) Electromechanical properties of superconductors for DOE fusion applications. Ekin, J.W.; Moreland, J.; Brauch, J.C. (National Bureau of Standards, Boulder, CO (USA). Center for Electronics and Electrical Engineering). Mar 1986. Contract AI01-84ER52113. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002760.

This is an interim report presenting data on superconductor performance under mechanical load, which are needed for the selection of superconductors and the mechanical design of superconducting magnets for DOE fusion energy systems. A further aim of the reported research is to measure and understand the electromechanical properties of promising new superconductor materials with strong application potential at high magnetic fields. Results include the following. The first strain vs. critical-current studies were made on a Chevrel-phase superconductor, $PbMo_6S_8$. Chevrel-phase superconductors were found to have a large strain effect, comparable in magnitude to A-15 superconductors like Nb_3Sn. Electromechanical-property measurements of an experimental liquid-tin-infiltrated Nb_3Sn conductor showed it to have an irreversible strain limit twice as large as bronze-process supercondutors and a significantly higher overall critical-current denstiy; the liquid-infiltration process thus has the potential for development of a practical Nb_3Sn conductors with both superior critical-current density and extremely good mechanical properties. Electromechanical parameters were obtained on several Nb_3Sn conductors that are candidate materials for superconducting fusion magnets, icluding conductors fabricated by the bronze, internal-tin, and jelly-roll processes. Thermal contraction data are reported on several new structural materials for superconductor sheathing and reinforcement, and a new diagnostic tool for probing the energy gap of practical superconductors has been developed using electron tunneling.

8443 (NLR-MP—85014-U) Analysis of high-Reynolds number wind-tunnel tests of the Semi-Spar. Willemsen, E.; Leynse, C.; Graaf, G. (National Aerospace Lab., Amsterdam (Netherlands)). Feb 1985. 11p. (CONF-850501—1). National Aerospace Lab. NLR, P.O. Box 90502, 1006 BM Amsterdam, Netherlands.

From Offshore technology conference; Houston, TX, USA (6 May 1985).

Aerodynamic load measurements were performed on a 1:50 scale model of the Semi-Spar concept in order to predict the loads exercised by the current on the full-scale structure. The test program comprised measurements with the model in even-keel as well as tilted conditions, in which also the effects of various ballast leg lengths were investigated. All tests were carried out in uniform flow conditions, whereby test results were corrected for wind-tunnel wall constraints. The effect of surface roughness on the measurements was investigated for various Reynolds numbers. A proper roughness was selected to ensure realistic load coefficients for the full-scale body. Results obtained by applying drag calculation rules for rough, three-dimensional, circular cylinders as well as platform design rules concerning shielding were in good agreement with the actual test results. Vertical forces proved to exercise a large influence on overturning moments, both in even keel and in tilted model conditions. This phenomenon is analyzed in more detail. 11 figs., 8 refs., 2 tabs.

8444 (SAND—85-1821) Determination of net heat fluxes and assessment of test-to-test thermal input variation for three large engulfing open pool fire/calorimeter tests. Nelsen, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1986. Contract AC04-76DP00789. 61p. (TTC—0575). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002884.

Three 30-minute large engulfing open pool fire tests were conducted to determine the local thermal input from the fire environment to a test article. The local thermal input was evaluated numerically based on experimental temperature measurements and expressed in terms of instantaneous and time-integrated local heat fluxes. Additionally, the variation in test-to-test temperatures was assessed and compared with a regulatory (10CFR71) fire. The test articles employed were large cylindrical calorimeters with physical dimensions of 137 cm (54 in) I.D., 6.4 m (21 ft) axial length and 3.18 cm (1.25 in) wall thickness. The pool was rectangular with dimensions 9.14 x 18.29 m (30 x 60 ft).

8445 (SAND—86-0679C) Alarm Multiplexer Communication System. Herrera, G.V. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 11p. (CONF-860654—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001418.

From 27. annual meeting of the Institute of Nuclear Materials Management; New Orleans, LA, USA (22 Jun 1986).

A low cost Alarm Multiplexer Communication System (AMCS) has been developed to perform the security sensor monitoring and control functions and to provide remote relay control capability for integrated security systems. AMCS has a distributed multiplexer/repeater architecture with up to four dual communication loops and dual control computers that guarantee total system operation under any single point failure condition. All AMCS hardware is commercially available and controlled by Sandia designed software. Each AMCS can control up to 4096 sensors and 2048 remote relays, with a fairly constant cost per channel independent of the system size. AMCS reports alarm status information to and is controlled by either one or two Host computers. This allows for independent operation of primary and backup security command centers. AMCS communicates with the Host computers over an asynchronous serial communication link and has a message protocol which allows AMCS to fully recover from lost messages or large blocks of data communication errors. This paper describes the AMCS theory of operation, AMCS fault modes, and AMCS system design methodology. Also, cost and timing information is presented. AMCS is being used and considered for several DOE and DoD facilities.

8446 (STEV-SB—86-10) Project 'Terminal Bergslagen'. Summary report of stage 2. Nilsson, P.O. (Statens Energiverk, Stockholm (Sweden)). Jun 1986. 217p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. File Number DE87750351.

In the second stage of the project the studies have treated the following sub-projects: Systems analyses, market for forest fuel, logging methods, transport, detached terminals, industry localized terminals, storing and drying, and peat. The value of forest fuel has been calculated at approximately 213 SEK per m_3 solid volume. Market studies have surveyed various categories of consumers. Costs have been calculated for possible methods and systems and the operating costs and experiences of the industry localized terminal at Froevifors Bruk are presented. A study of storing comminuted green logging residues having various particle sizes was made. An estimate was made of the peat supply from bogs within the test area and possibilities to integrate the handling and burning of peat and forest fuel were reviewed. (G.B.).

8447 (UCRL—95556) Diamond turning wavefront correctors: Opening new optical design flexibilities. Patterson, S.R.; Saito, T.T.; Meinel, A.B.; Meinel, M.P.; Stacy, J.E. (Lawrence Livermore National Lab., CA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1986. Contract W-7405-ENG-48. 8p. (CONF-860880—38). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002385.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A wavefront corrector (WFC) is a component in an optical system which corrects for errors of an earlier optic which is imaged onto it. WFC's can be used in two-stage optics in which a primary mirror with large surface errors can be incorporated in the "foveal mode" to make an ultra-wide-field system and yield an upgraded high acuity image. WFC's, therefore, offer significant cost advantage for fabricating large telescope primaries. We report the JPL-LLNL first embodiment of this concept which includes a non-axisymmetric WFC containing greater than a wave of astigmatism and two waves of coma (1 wave = 0.63 μm). The 6 cm diameter WFC was diamond turned on a super invar substrate covered with 13% phosphorous electroless nickel. Metrology of the WFC with this great an error to 10th wave accuracy was challenging.

4203 Lasers

REFER ALSO TO CITATION(S) 8552, 8747, 8779

8448 (AD-A—172503/5/XAB) Scale effects in a c-w HF chemical laser. Technical report. Sentman, L.H.; Carroll, D.L.; Theodoropoulos, P.; Gumus, A. (Illinois Univ., Urbana (USA). Dept. of Aeronautical and Astronautical Engineering). Sep 1986. 83p. (AAE—86-5). NTIS, PC A05/MF A01.

Scale effects when the size of a c-w HF chemical laser was reduced by a factor of two were studied experimentally and theoretically. When the saturated gains of the single-channel CL I laser and the two channel CL II laser were the same, the CL I power was 70-80% of the CL II power. This suggests that for only a 25% performance penalty, the size, weight, and gas requirements of a laser can be reduced by a factor of two. The power-spectral distributions of the CL I and CL II lasers, when the saturated gains were the same, were nearly identical. When the two lasers had the same cavity losses, the CL I power was an average of 45% of the CL II power. The Blaze II and MNORO3SR laser computer simulations gave good agreement with data as a function of mass flow rate, cavity losses, pressure, and size of the laser. Time-dependent oscillations on lines whose saturated gain did not fill the unstable resonator had a period of 47 ns. These oscillations did not occur for Fresnel numbers less than 3.2 and their amplitudes increased as the fraction of the resonator filled by the saturated gain of the oscillating line decreased. A 7-ns oscillation, which was superimposed on top of the 47 ns oscillation, was probably a mode beat of the laser.

8449 (PB—87-103727/XAB) High-pressure continuously tunable CO_2 laser. Christensen, C.P. (Potomac Photonics, Alexandria, VA (USA)). Sep 1984. 18p. NTIS, PC A02/MF A01.

Operation of carbon dioxide waveguide lasers at laser gas pressures of several atmospheres can significantly increase peak-output power and optical-pulse energy and allow continuous-wavelength tunability over a broad spectral band. In the investigation, the feasibility of CO_2 waveguide laser operation at elevated pressures is demonstrated. An advanced waveguide laser excited by a high-power radio-frequency generator and employing novel discharge concepts is constructed and experimentally characterized. Significant increases in laser pulse energy and peak-output power are observed, and factors influencing laser efficiency and range of operating pressure are explored. As a result of its improved operating characteristics, this advanced waveguide laser is expected to find applications in laser radar, remote sensing, laboratory instrumentation, and materials processing.

8450 (SAND—86-1736C) Coupling and absorption phenomena in semiconductor-clad dielectric optical waveguides. Carson, R.F.; Batchman, T.E. (Sandia National Labs., Albuquerque, NM (USA); Virginia Univ., Charlottesville (USA). Dept. of Electrical Engineering). 1987. Contract AC04-76DP00789. 11p. (CONF-870105—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010138.

From International conference on integrated optics and optical fiber communication (IOOC); Reno, NV, USA (19 Jan 1987).

Propagation characteristics of semiconductor-clad dielectric optical waveguides are influenced by mode coupling between the lossless dielectric waveguide and a lossy (absorptive) semiconductor cladding. Influences of layer thickness and absorption in the semiconductor are discussed.

8451 (UCID—20912) Temperature rise due to inclusions in polymer bonding agents. Pitts, J.H. (Lawrence Livermore National Lab., CA (USA)). 6 Nov 1986. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002736.

It is concluded that polymer bonded edge cladding is absolutely safe at a maximum flux of 10 kW/cm² for carbon inclusions if the size of the inclusion in the polymer bonding agent is less than 1 μm diameter. If the maximum flux level is half that used in the analysis (5 kW/cm²), the temperature rise for small diameter inclusions would be half that shown by the curve comparison, dust and iron oxide inclusions of 1 μm can withstand flux levels of about 140 and 14 kW/cm², respectively. Polymer bonding agent with inclusions of 1 or 2 μm maximum diameter can be manufactured by filtering the polymer.

8452 (UCRL—95346) Laser welding of thin cross sections. Lingenfelter, A.C. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1986. Contract W-7405-ENG-48. 18p. (CONF-8610147—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000834.

From American Welding Society Interagency Mechanical Operations Group and Joint Operation Weapons Operations Group meeting; Albuquerque, NM, USA (13 Oct 1986).

The Laser Processing Facility of the Material Fabrication Division at the Lawrence Livermore National Laboratory (LLNL) currently has three pulsed Nd-YAG lasers dedicated to metal working activities. The lasers are used for precision cutting, drilling, welding, and brazing. The pulsed Nd-YAG laser has limited penetration capability for welding and therefore has been applied to welding cross sections generally less than 0.040 inches in thickness. At LLNL the process has proven particularly useful for welding cross sections less than 0.005 inches thick. Four examples of thin cross section parts fabricated with the laser are cited to illustrate the usefulness of the process.

8453 Multilayer structures for x-ray laser cavities. Ceglio, N.M.; Stearns, D.G.; Hawryluk, A.M. (Lawrence Livermore National Lab., P.O. Box 5508, L-473, Livermore, CA 94550). pp 360-366 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—). Contract W-7405-ENG-48.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Recent demonstrations of the generation of amplified spontaneous emission (ASE) at soft x-ray wavelengths have spurred interest in normal incidence multilayer structures for use a x-ray laser (XRL) cavity mirrors. Calculations indicate that cavity mirrors can provide significant enhancement of XRL output, and drive the oscillations to the saturation limit. Novel ideas for cavity output coupling may expand the versatility of XRL devices, while encouraging the marriage of lithographic and multilayer technologies to the general benefit of x-ray optics. Preliminary tests of a double pass cavity have already been conducted. These tests point out the importance of detailed cavity design issues, such as precision mirror alignment, mirror damage dynamics, and detailed mirror calibration to the future success of this field.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 7905

8454 (ANL—86-38) Flow enhancement of annulus damping. Mulcahy, T.M. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002754.

Significant increases in flow damping were observed for a tube passing through a plate when a sharp-edge raised-diameter constriction was added to the hole in a plate subject to a constant pressure drop. A correlation of the data in the form of a concentrated viscous damper (dashpot) is given which will be useful in structural dynamic analysis.

8455 (ESDU—5041) Boiling inside tubes: General aspects and estimated wet-wall heat transfer. (Engineering Sciences Data Unit Ltd., London (UK)). Dec 1985. 42p. ESDU.

Data item ESDU 85041, a part of the Heat Transfer Subseries, discusses the problems met in thermal rating a vaporizer in terms of the flow patterns in boiling flow, the conditions for nucleate boiling, considerations of burnout and dryout, the use of mixtures, and the flow instabilities that can occur. Nine correlations for wet-wall boiling of a pure liquid are evaluated against over 3000 experimental points taken from the literature and the results tabulated. The most reliable prediction method was chosen and a graph

shows its performance against experimental data for water, ethylene glycol, and a number of refrigerants. A calculation procedure based on that correlation is provided, including checks on whether nucleate boiling or statified flow exists. The calculation of the surface area required to reach a selected flow quality is also given. A practical worked example illustrates the use of the method. It applies to steam generators and to vaporizers for process fluids. Large water tube boilers used in power generation are outside the scope, however.

8456 **(TKK-KO/ET—9) Determination of pressure drop in two-phase flow.** Kivioja, K.; Fagerholm, N.-E. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1985. 85p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750395.

The purpose of this study was to examine two-phase flow and to find reliale methods for predicting pressure drop during two-phase flow. The study was carried out as a literature survey. First some general aspects of two-phase flow and existing flow patterns are presented, followed by some well-known theoretical and experimental correlations. Some of them are included here more for historical reasons than for their accuracy. 14 correlations are given for calculating the frictional pressure gradient and 15 correlations for evaluating the average void fraction of the flow. The predictions are compared with each other and with selected experimental data from the literature. Comparative studies of correlations and recommendations in handbooks were also examined. Based on these it is here recommended that the frictional pressure drop be calculated with the correlation of Friedel, for which the standard deviation of error is 30% for 1-component and 40% for 2-component flows. The correlation of Rouhani is unique in evaluating the void fraction of the flow. Its standard deviation of error is 18% (1- and 2-component). Finally some methods for defining singular pressure drops are presented. Their validity is assured experimentally over only a narrow range of parameters. Despite this they are preferable to the usual homogeneous model.

4205 Materials Testing

REFER ALSO TO CITATION(S) 8121, 8127, 8404

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 8360, 8361, 8392, 8491

8457 **(DOE/ER/45216—T3) Electronic and structural properties of semiconductor heterojunctions: Technical progress report, December 16, 1985-October 31, 1986.** Chung, Y.W. (Northwestern Univ., Evanston, IL (USA)). Nov 1986. Contract FG02-85ER45216. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002769.

In the current grant period, we demonstrated that α-Sn can be grown epitaxially onto clean single crystal surfaces of CdTe(110) at room temperature under ultrahigh vacuum conditions. The Sn 3d XPS peak area was found to increase linearly with the amount of Sn deposited, as indicated by a quartz crystal monitor, with a break in the slope at the completion of each monolayer. This shows that α-Sn grows layer-by-layer on CdTe. Using angle-resolved photoemission, we measured the variation of Sn, Cd, and Te 3d XPS signals as a function of emission angles. By applying the simplex optimization algorithm, we were able to show that the α-Sn/CdTe junction is atomically abrupt.

8458 **(GEPP-TIS—965) Analytical formulas for the self-inductance of a single-layer circular coil and for the mutual inductance of several symmetrical arrangements of circular loops.** Miller, H.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 30 Oct 1986. Contract AC04-76DP00656. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003086.

The analytical formulas for the self-inductance of a cylindrical current sheet (solenoid of any size), the mutual inductance of two coaxial current loops, and the mutual inductance of two coaxial solenoids of the same diameter are presented, together with a simple iteration method for evaluating the formulas to any desired degree of accuracy.

8459 **(SAND—86-1228C) Latent failures due to electrostatic discharge in CMOS integrated circuits.** Gammill, P.E.; Soden, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-8609149—2). NTIS, PC A02. File Number DE87002480.

From Electrical overstress/electrostatic discharge symposium; Las Vegas, NV, USA (23 Sep 1986).

Electrostatic discharge (ISD) caused two CMOS integrated circuits (ICs) to fail in a latent manner due to gate oxide rupture. One failure occurred during an experiment designed to test for latent failures where a set of ICs was subjected to simulated electrostatic discharge (VZAP) followed by life testing. Another failure occurred during the operation of a system being readied for a satellite application.

8460 **(SAND—86-1896C) High speed optical isolator for radar applications.** Anthes, J.P.; Garcia, P.; Lau, K.Y.; Ury, I. (Sandia National Labs., Albuquerque, NM (USA); Ortel Corp., Alhambra, CA (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870114—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86015824.

From IEEE/OSA topical meeting on picosecond electronics and optoelectronics; Lake Tahoe, NV, USA (14 Jan 1987).

A high-speed unidirectional electronic coupler/switch that utilizes optoelectronic components is demonstrated. High attenuation of counter propagating radar signals offers improved radar performance.

8461 **(SAND—86-2038) Through-hole optimization using plasma desmearing system.** Gentry, F.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002835.

To assure a reliable multilayer printed wiring product, all traces of resin smear must be removed from interconnect holes prior to electroplating. Plasma processing will remove this resin smear from the new laminates being introduced to our industry as well as the standard epoxy materials. Plasma desmearing also has the potential of eliminating many of the negative aspects associated with "wet" chemical processing. This report describes the full characterization of a production plasma etchback/desmear system (PEDS), as used in a prototype fabrication environment. Processing parameters were established for epoxy, polyimide, and acrylic resin systems.

8462 **(SAND—86-2495C) System for placement and routing for VLSI consisting of rectilinear macrocell assemblies.** Hudson, J.A.; Wisniewski, J.A.; Wada, M.M.; Peters, R.C. (Sandia National Labs., Albuquerque, NM (USA); Kirk-Mayer, Inc., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 9p. (CONF-870108—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002058.

From 20. annual Hawaii international conference on system sciences; Honolulu, HI, USA (6 Jan 1987).

A new computer program for performing placement and routing of integrated circuits has been developed. This software achieves an important step in VLSI system design by providing support for rectilinear (i.e., simple closed polygons where all corners are right angles) macrocell assemblies. Rectilinear shapes occur naturally in VLSI designs in structures such as a PLA, a RAM, or a ROM. Due to the generalized nature of the design of this system, support is also provided for gate arrays and integrated circuits where rows of standard cells are intermixed with macrocells. The paper discusses the motivation for the development of this VLSI computer-aided design software and provides an overview of the capabilities of the system and the models and algorithms that are used.

8463 **(UCID—20898) Development of a two-dimensional, solid state device model (BURN2D).** Orvis, W.J.; Yee, J.H.; Khanaka, G.H. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002739.

During the last year, we have developed two versions of the solid state device model BURN2D. This is a two-dimensional, solid state device model for operational studies at high power levels. These studies include calculation of device operation until the device fails due to electrically induced heating. These calculations are the two-dimensional extensions of the work being done with the one-dimensional code BURN. The first version of the code uses explicit finite differences to advance the densities of the charge carriers and the external circuit, it then uses a fast Poisson solver to calculate the potential distribution. The second version of the code uses implicit finite differences for all of the equations, in the same manner as the operation of the one-dimensioal code.

8464 **(UCID—20909) Analysis of diode failure energies.** Orvis, W.J.; Khanaka, G.H.; Yee, J.H. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002735.

We have calculated curves of diode failure threshold energy for a small signal diode similar to the 1N4148 for high voltage, forward and reverse square pulses, and microwave pulses. These curves were generated with the solid state device models BURN42 (one-dimensional) and BURN2D (two-dimensional). The shapes of these curves are not simple. This is especially true of the curves of diode failure threshold energy versus frequency, which decrease with frequency for long pulses and increase with frequency for short pulses. The cause of this phenomena is due to selective heating of the device, either in the active region or in the subatrate. If the heating is in the small active region, then it will take only a small amount of energy to cause the temperature to rise to the failure level (800 K assumed in this report). If the heating is in the subatrate, it will take more energy since it has a larger volume. The switching between heating in the junction or the substrate is controlled by several processes, all of which result in forcing the electric field to be in or out of the junction, which determines where the heating will take place. We are performing a parameter study to determine the sensitivity of the failure threshold energy to changes in a devices design.

8465 **(UCRL—15851) New algorithms in the DIODE2D code.** Goplen, B.; McDonald, J. (Mission Research Corp., Alexandria, VA (USA)). Sep 1986. Contract W-7405-ENG-48. 35p. (MRC/WDC-R—105). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002507.

The DIODE2D code has been modified to include the following new features: (1) a thermal algoithm which includes conduction, convection, and radiation options and a multiple of the electronic time step; (2) numerous iterative acceleration options and a convergence test to speed up the electronic algorithm; (3) conversion to FORTRAN 77 standard; and (4) three-dimensional surface and contour plotting algorithms, including logarithmic capability.

8466 **Hopping magnetoconduction and the random structure in quasi one-dimensional inversion layers.** Kalia, R.K.; Xue, W.; Lee, P.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **57**: No. 13, 1615-1618(29 Sep 1986). Contract W-31-109-ENG-38.

Conductance fluctuations due to variable-range hopping in 1D metal-oxide-semiconductor field-effect transistors are investigated in the presence of a magnetic field. With an increase in magnetic field, the Zeeman effect shifts the fluctuations to lower or higher chemical potentials. These shifts reflect the relative populations and occurrence of hopping from singly and doubly occupied sites. Combined with density-of-states measurements, they can provide an estimate of the intrasite Coulomb repulsion in 1D metal-oxide-semiconductor field-effect transistors. The orbital effect on conductance fluctuations is also discussed.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 8304, 8305, 8578

8467 (KFK-PEF—4-Vol.3, pp 831-849) **Optimization of small oil-fired burners: Reduction of NOsub(X), unburned hydrocarbons, and additional pollutants.** Wittig, S.; Kutz, R.; Steinebrunner, K. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Of primary interest is the interdependence of the flow field and the fuel atomization and its influence on pollutant emissions. After a brief illustration of the flow field and spray measurements, typical emissions are compared with results obtained from advanced models for the calculation of NOsub(x). The limitations of the model are explained. Finally, optimization rules are discussed. It is shown that by matching the flow field with the fuel atomization considerable reduction in the pollutant emissions are achieved.

8468 **(STEV-FBA—86-3) Wood gas flames/hot gas burners. An investigation of methods to improve the efficiency of the final stage of combustion when burning gasifying solid biomass fuels.** Rudling, L. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Jun 1985. 216p. (In Swedish). (STUDSVIK-EB—85-28). NTIS (US Sales Only), PC A10/MF A01. File Number DE87750339.

Different methods to increase the combustion efficiency during burning of wood gas have been investigated. Burner of different designs were tried. By improving the mixing of pyrolysis gases and the combustion air in the burner it was possible to considerably increase the combustion efficiency. At an oxygen content of only one percent it was possible to get the carbon monoxide concentration as low as $<=100$ ppm in the flue gas. It was also found that the combustion temperature had in general no influence on the degree of outburning, provided that the temperature was kept above 725-750 degrees C. However, during the char burning phase it was found that the combustion temperature has a higher influence on the degree of outburning. The results indicated that the carbon/hydrogen ration in the fuel, was an important factor regarding the reaction path, and the rate of combustion dependence on the combustion temperature. With 48 refs.

8469 **Pulse combustion: Characteristics, applications and research needs.** Zinn, B.T. (School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA 30332). pp 7-11 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, D.C.; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper briefly describes the types and operational characteristics of pulse combustors which have been developed to date. Next, the advantages resulting from the use of pulse combustors in energy consuming domestic and industrial applications are discussed. Finally, past and potential applications of pulse combustors in such fields as heating, chemical processing and drying are discussed and some research needs are outlined.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 8334, 8443

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 8154, 8155

8470 (KFK-PEF—4-Vol.3, pp 757-775) **Development of techniques for combined removal of dusts and gaseous pollutants.** Loeffler, F.; Gaeng, P.; Hedden, K.; Balekdjian, O. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The technique is based on the removal of acid pollutant gases (SO2, HF) by injection of alkaline dusts at high temperatures (dry absorption process). The addition of calcium hydroxide between two rotary kilns guarantees the optimum temperature for SO2 removal. This report gives information on the production plant and results of experiments so far performed. Additionally, laboratory-scale investigations are described. These experiments are concerned with the reaction kinetics of SO2 with fine dusts of Ca(OH)2 and CaO and dust removal at high temperatures.

8471 (KFK-PEF—4-Vol.3, pp 817-830) **Improved mist eliminators in flue gas scrubbers; a requirement for measures to reduce emissions.** Conrads, M.; Klar, M.; Wurz, D. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Lab experiments and plant measurements show, that a liquid water content below 10 mg/m³ can be reached even when the mist eliminator's spray cleaning is on. The droplet load of the clean gas can increase drastically during the spray cleaning of the eliminators. The position of the (usual two) mist eliminator layers in the absorber tower head is a very important item. The SO_3 elimination rate of a counter current scrubber is about 50%. Fly ash particulates larger than about 1.5 μm virtually cannot pass the scrubbers.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

8472 (DOE/ER/40238—1, pp 3554-3556) **Side-injected-laser plasma accelerator.** Katsouleas, T.; Dawson, J.M.; Sultana, D.; Yan, Y.T. (Univ. of California, Los Angeles). 1985. IEEE, 345 East 47th St., New York, NY 10017. File Number TI86011479. (CONF-850504—Pt.2).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A new method for driving relativistic plasma waves capable of ultra-high acceleration gradients (order 1GeV/cm) is presented. By injecting a single laser frequency from the side, rather than colinearly with the accelerated particles, both pump depletion and particle dephasing may be avoidable. The coupling of the side injected laser to the relativistic plasma wave via a pre-formed density ripple in the plasma is modelled analytically and with computer simulation.

8473 (INIS-SU—352, pp 260-263) **Development of software for charged particle accelerator design automation.** Budkin, V.A.; Volodin, V.A.; Gul'yants, A.L. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Main programs of the computer-aided design system (CADS) intended for numerical simulation of electromagnetic fields in accelerating and focusing systems of electron and ion linacs as well as for simulation of particle beams are described in short. CADS is an open system and is designed for operation with the ES1010 computer. It can be easily adapted for any minicomputer, in particular, for the SM-4. The system considered envisages use of man-machine dialog within the framework of PRIMUS collective access system. Further CADS development will be connected with development or adaptation of problem-oriented programs as well as with modernization of the whole-system means designed for providing maximum conveniences forusers.

8474 **(RAL—86-069) Collider constraints in the choices for wavelength and gradient scaling.** Lawson, J.D. (Rutherford Appleton Lab., Chilton (UK)). Jun 1986. 6p. (CONF-860629—63). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900168.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

During the last few years many suggestions have been made for novel accelerating schemes, with the aim of making centre of mass energies of 1 TeV and above available for e^+e^- collisions at a socially acceptable cost. A wavelength range from microns to centimetres, and field gradients from tens to thousands of MeV per metre have been considered. It is now evident that the need for high luminosity with acceptable power cost in the face of destructive collider constraints imposes severe restrictions on the choices available. An attempt is made to examine these in general way, but with emphasis on wavelength and gradient scaling. Non-harmonic schemes, where an equivalent wavelength must be assigned, will be included in the survey, and the use of multiple bunches considered. The need for essentially new inventive suggestions will be emphasized.

8475 **(BNL-tr—1055) An elementary presentation of the PS "beam control" system.** Boussard, D. (Brookhaven National Lab., Upton, NY (USA)). 23 Feb 1973. Contract AC02-76CH00016. Translation of MPS/SR/Note/73-10. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002821.

The PS synchrotron control system is explained in general terms, covering the topics of frequency control, beam transfer, damping, stability, conservation of longitudinal emittance, and second order problems. (LEW)

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 8505, 8521

8476 **(BNL—38813) Performance of six 4.5 m SSC [Superconducting Super Collider] dipole model magnets.** Willen, E.; Dahl, P.; Cottingham, J.; Garber, M.; Ghosh, A.; Goodzeit, C.; Green, A.; Herrera, J.; Kahn, S.; Kelly, E. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-860870—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002579.

From 13. international conference on high energy accelerators; Novosibirsk, USSR (7 Aug 1986).

Six 4.5 m long dipole models for the proposed Superconducting Super Collider have been successfully tested. The magnets are cold-iron (and cold bore) 1-in-1 dipoles, wound with current density-graded high homogeneity NbTi cable in a two-layer cos θ coil of 40 mm inner diameter. The coil is prestressed by 15 mm wide stainless steel collars, and mounted in a circular, split iron yoke of 267 mm outer diameter, supported in a cylindrical yoke containment vessel. At 4.5 K the magnets reached a field of about 6.6 T with little training, or the short sample limit of the conductor, and in subcooled (2.6 - 2.4 K) liquid, 8 T was achieved. The allowed harmonics were close to the predicted values, and the unallowed harmonics small. The sextupole trim coil operated well above the required current with little training.

8477 (INIS-SU—352, pp 222-225) **Methodical errors in measuring the field in an accelerator with HF quadrupole focusing.** Barsukov, A.B.; Belyaev, S.K.; Igoshin, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The method of field electric component calculation in the linear ion accelerator with the quadrupole focusing intended for the reduction of systematic errors, occurring in the course of accelerating and focusing electromagnetic field structure investigation by the small perturbed method, is suggested. Formulas for the determining of the resonator frequency detuning dependence in quadrupole gap geometrical centre on the disturbing body radius are derived. It is shown that using these formulas allows to reduce the systematic error to the random level. Thus, when using a disturbing body with 6-8 mm diameter the maximum measurement error does not exceed 1.5%.

8478 (INIS-SU—352, pp 226-228) **Studying the electromagnetic oscillation spectra in resonators excited by a charged particle beam.** Bukharin, V.L.; Zverev, B.V.; Sobenin, N.P.; Tret'yakov, A.G. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Equations, making up the basis of KRAB (FORTRAN-4 the ES computers) program complex, intended for the calculation of amplitudes and phases of electric fields of aximuth-homogeneous mode of oscillations, excited in azially symmetric resonators by both nonmodulated and modulated charged particle bunch sequence, are presented. Resonator excitation is calculated within the framework of quasi-selfconsistent problem. During the particle dynamics calculation the oscillation mode, having the maximum interaction with the beam, is taken into account. The calculation time of electric field 5-6 oscillation modes underbunch division into 20-30 large particles and 4-5 extraneous current harmonic accounting makes up 4-7 min at the ES-1060 computer. The optimizing KROP complex, intended for numerical minimization of azimuth-homogeneous electric field amplitudes by resonator geometrical configuration change is developed on the basis of the KRAB complexes. The equations presented allow also to restore un iquely the electric charge linear density distribution in a bunch. Experimental numeric technique, realized in BVNCU1 (nonmodulated bunch sequence) and BVNCH2 (modulated sequence) programs is developed.

8479 (INIS-SU—352, pp 425-428) **Studying the high-frequency characteristics of resonance heterogeneities of a synchrotron vacuum chamber.** Bogdanovich, B.Yu.; Volodin, V.A.; Kaminskij, V.I.; Obraztsov, N.V.; Putkin, Yu.M.; Shal'nov, A.V. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

In the framework of investigations of accelerated beam interaction with cyclic accelerator vacuum chamber carried out in connection with designing the 3000 GeV accelerating and stirage facility experimentally determined are RF-characteristics (eigen resonance frequency, Q-factor and shunting resistance) of three typical resonance heterogeneities of the vacuum chamber: chamber cylindrical broadening, link-up unit which represents vacuum tee-joint for connection of ion-guide sections and attachment of pumps and beam position monitor (pick-up-electrode). The investigations have been performed using spacially fabricated models.

8480 (INIS-SU—352, pp 429-431) **Model measuring the ultrarelativistic bunch energy losses in heterogeneous elements of a synchrotron vacuum chamber.** Bogdanovich, B.Yu.; Kaminskij, V.I.; Putkin, Yu.M.; Shal'nov, A.V. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The facility and the technique for experimental measuring total energy losses due to field excitation in synchrotron chamber elements are described. The technique is based on simulation of ionoguide particles bunch passage by generator current pulse transmitted trough the conductor mounted in the investigated element along the trajectory of bunch motion. Energy losses are determined by signal wave form distortion in the investigated element. The applicability of the method for determining ultrarelativistic bunch energy losses is proved. The facility for performing measurements consists of a nanosecond pulse generator and two-channel stroboscopic oscilograph which permits to simultaneously observe the shape of the distorted pulse passed through the arm with the investigated element and reference pulse passed through the arm with reference element (coaxial waveguide). As an example the results of measurements of bunch losses during the passage through the cylindrical resonator are presented. The conclusion is drawn on the applicability of the method under consideration for measuring total energy losses of an accelerated beam due to field excitation in resonance elements with complex surface form for which theoretical calculations are extremely complicated.

8481 (INIS-SU—375) **Method of integral equation in the diffraction problem of the E-plane corner in the rectangular waveguide.** Kirilenko, A.A.; Rud', L.A.; Tkachenko, V.I. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1984. 49p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700225.

A solution of two-dimensional problems of the wave diffraction on the discontinuities with segment-linear boundary has been obtained in a strong formulation of the integral equation methods. A system of integral equations of the second kind with continuous kernels allowing to analyse analytically a field behaviour near the corners of the boundaries is set up using the Green function of the parallel-plate waveguide. On this base general representations concerning peculiarities of the field behaviour near wedges are refined. Data characterizing an efficiency of the solution obtained are given. Electrodynamic, characteristics of the symmetrical and non-symmetrical E-coners are considered. 14 refs.; 10 figs.; 4 tabs.

8482 (KMU-HEP—85-05) **Beam-beam interaction in high energy linear electron-positron colliders.** Ritter, S. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic)). Apr 1985. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700226.

The interaction of high energy electron and positron beams in a linear collider has been investigated using a macroparticle Monte Carlo method based on a Cloud-In-Cells plasma simulation scheme. Density evolutions, luminosities, energy and angular distributions for electrons (positrons) and synchrotron photons are calculated. Beside beams with a symmetric transverse profile also flat beams are considered. A reasonably good agreement to alternative computer calculations as well as to an analytical approximation for the energy spectrum of synchrotron photons has been obtained.

8483 (LBL—22342) **Control of the fields due to superconductor magnetization in the SSC [Superconducting Super Collider] magnets.** Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 7p. (CONF-860914—11). NTIS, PC A02. File Number DE87002548.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

Field uniformity of better than one part in 10,000 is required for the dipole magnets for the Superconducting Super Collider (SSC). The high field dipole and quaddrupole magnets proposed for the SSC generate higher multipole components of field due to

magnetization (persistent currents) in the superconductor. When the superconductor filament diameter is of the order of 20μm, the sextupole term alone is about 17 parts in 10,000 at an injection induction of 0.3 tesla in the SSC dipole magnets at a radius of 1 cm. This paper shows calculations of the magnetization phenomena which agree very well with magnetic measurement. Several passive methods for removing the sextupole component and higher components of the field generated by magnetization of the superconductor in the SSC dipole magnets are presented in the paper.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 8242, 8345, 8476, 8477, 8478, 8479

8484 **(BNL—38749) Transient beam loading and rf power distribution in the SSC [Superconducting Super Collider].** Raka, E.C. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 4p. (CONF-8606215—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002592.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Transient beam loading will occur in the SSC at injection as the fifteen individual batches from the High Energy Booster are loaded box-car fashion into the main rings. Periodic transient beam loading will be present also at injection due to the gaps between the successive batches as well as the gap that remains to be filled. Even after the rings have been "filled" there will remain the abort gap of 3.1 μsec. This can produce significant modulation of the phase and amplitude of the rf voltage seen by those bunches immediately following it unless corrective measures are taken. Two different methods of reducing this modulation will be discussed, each of which put certain requirements on the rf power distribution system.

8485 **(BNL—38810) Operation of general purpose stepping motor controllers at the National Synchrotron Light Source.** Stubblefield, F.W. (Brookhaven National Lab., Upton, NY (USA)). Oct 1986. Contract AC02-76CH00016. 9p. (CONF-861006—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002588.

From Nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A prototype and four copies of a general purpose subsystem for mechanical positioning of detectors, samples, and beam line optical elements which constitute experiments at the National Synchrotron Light Source facility of Brookhaven National Laboratory have been constructed and placed into operation. Construction of a sixth subsystem is nearing completion. The subsystems effect mechanical positioning by controlling a set of stepping motors and their associated position encoders. The units are general purpose in the sense that they receive commands over a standard 9600 baud asynchronous serial line compatible with the RS-232-C electrical signal standard, generate TTL-compatible streams of stepping pulses which can be used with a wide variety of stepping motors, and read back position values from a number of different types and models of position encoder. The basic structure of the motor controller subsystem will be briefly reviewed. Short descriptions of the positioning apparatus actuated at each of the test and experiment stations employing a motor control unit are given. Additions and enhancements to the subsystem made in response to problems indicated by actual operation of the four installed units are described in more detail.

8486 **(CERN-EP—86-129) Recent development of high temperature metal targets for ISOLDE.** Bjoernstad, T.; Hageboe, E.; Hoff, P.; Jonsson, O.C.; Kugler, E.; Ravn, H.L.; Sundell, S.; Vosicki, B. (Bergen Univ. (Norway). Dept. of Chemistry; Oslo Univ. (Norway). Dept. of Nuclear Chemistry; European Organization for Nuclear Research, Geneva (Switzerland)). 1986. 23p. (CONF-860815—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900153.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

Pure metals are among the most successful target materials for on-line mass separators. In particular, solid targets of refractory metals are excellent for this kind of use since they release no impurities which may interfere with the functioning on an ion source. In the present paper, we will describe the latest development of ISOLDE ion sources and their combination with a number of new metallic target materials and outline the current and potential performance of the new systems. The ISOLDE mass separators are situated at the CERN synchro-cyclotron (SC), which provides a 910 MeV ^{3}He beam and a 600 MeV proton beam which may reach an intensity of 4 microampere. Due to the long range of these projectiles, large amounts of target materials 10-300 g/cm^2 may be used at ISOLDE. The intensities of the secondary beams of unstable nuclei reaches 10^{11} atoms/s per microampere of incident proton beam. 25 refs., 11 figs.

8487 **(CERN-EP—86-135) Beam heating of thick targets for on-line mass-separators.** Eaton, T.W.; Ravn, H.L. (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Sep 1986. 19p. (CONF-860815—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900147.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

Energy deposition computations have been made on a variety of target materials utilized for the production of radio-isotopes by means of 600 MeV protons. Results have shown that, when a proton current of 100 μA is assumed, dispersed target materials such as uranium carbide powder and magnesium oxide, are best able to withstand the energy absorbtion and consequent beam heating, without the need of additional cooling. Modified foil targets of titanium, zirconium and tantalum appear also capable of withstanding a full beam current whilst liquid metal targets in their present form appear to have limitations, in terms of the maximum allowable beam current. A redesign of the target container is proposed which allows higher protons currents to be used with these targets also. 1 ref., 5 figs., 4 tabs.

8488 **(DOE/ER/10699—T5) Essential modeling of a high energy physics data collection/analysis system.** Linnemann, J.; Ward, P.; Gibbard, B.; Hedin, D.; Hoftun, J.; Loken, S.; Protopopescu, S.; Trippe, T.; Zeller, M. (Michigan State Univ., East Lansing (USA); Yourdon, Inc., New York (USA); Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA); Brown Univ., Providence, RI (USA); Lawrence Berkeley Lab., CA (USA)). 23 Feb 1986. Contract AC02-80ER10699. 14p. NTIS, PC A02. File Number DE87002216.

This paper will describe the experiences of participants in the DO project with the use of structured analysis. The DO project uses the Tevatron II particle accelerator facility at Fermilab. Tevatron II operates within a ring with a four-mile circumference, and is so nameed because it can accelerate particles to energies of a tera (10 to the 12th power) electron volt. The project involves placing a collision detector at a point on the accelerator ring (location DO) where beams of protons and antiprotons can be made to collide. Data from the various instruments within the detector will be captured and analyzed by a complex, multiprocessor real-time system. The software effort must deal in real time with 40 megabytes/second of input data, and must perform detailed analysis on an "interesting" subsample of this input amounting to about 2 terabytes per year. The project scope envisions an estimated 100 man-year effort over 3 years, producing 200,000 to 400,000 lines of finished code. One of the major difficulties in the project has been problem definition. The fact that the researchers are both users and implementers has the drawback that one cannot simply refuse to start design until requirements are fully agreed on by all parties - there is no easily-defined administrative division, since many people are involved both in hardware and software development, and deadline pressures occur in various areas for "finished code." Many requirements are in fact fairly nebulous, and one of the uses of formal design has been in specifying what was in fact required.

8489 **(EFI—810(37)-85) Polarized target at the Erevan synchrotron.** Asaturyan, M.M.; Vartapetyan, G.A.; Belyaev, A.A.; Get'man, V.A. (Erevanskij Fizicheskij Inst. (USSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700242.

The polarized proton target used at the Erevan synchrotron for the pion photoproducton experiments is described. The target operating characteristics obtained in experiment on measuring the T-asymmetry in the $\gamma p \rightarrow p\pi^0$ reaction are presented. 10 refs.; 6 figs.; 2 tabs.

8490 (INIS-SU—352, pp 203-205) **Analysis of accelerating systems with slits by the method of partial areas.** Orlov, A.K. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Design and theoretical investigation results on the analysis of electrodynamic properties of accelerating systems representing a chain of resonators with azimuthal slits are generalized. The relation between the electric field tangential component in a slit and the magnetic field in the resonator central region is derived along with the system of uniform equation for the binding resistance determination. Numerical calculation results for the LUEh-2000 accelerator accelerating section are considered as an example.

8491 (INIS-SU—352, pp 206-208) **Calculation and synthesis of resonators by the method of generalized harmonic polynomials.** Orlov, A.K.; Skrydlyak, I.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Peculiarities of the magnetic field eigenfrequency calculation as well as of the resonator geometry and shunt resistance by the method of generalized harmonic polynomials are considered. It is shown that the calculation error does not exceed 1-2%.

8492 (INIS-SU—352, pp 410-414) **System for proton beam slow extraction from the IHEP accelerator with new magnets.** Ado, Yu.M.; Lyudmirskij, Eh.A.; Naumov, A.A.; Kholodenko, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The construction of improved septum-magnets used for beam slow extraction from the IHEP accelerator is described. The performance of the beam slow extraction system is based on resonance swing of radial betatron oscillations induced by excitation of the third orders resonance. Mounting in the accelerator of four unified septum-magnets is envisaged. The septum-magnet core is manufactured of high quality structural steel. The sheets are separated with fibre-glass laminate insulating pads of 0.12 mm thickness. The put into operation septum-magnets of new construction are characterized by high reliability, simplicity in adjustment and low gas emission into vacuum volume under pressures up to 1.34×10^{-8} Pa. The system of beam slow extraction with the considered magnets worked out 9×10^5 accelerator cycles without failure. The extraction efficiency attained (85 +- 2.5)%.

8493 (INIS-SU—352, pp 436-440) **Problems of designing the injection system for the TIS heavy ion synchrotron.** Aver'yanov, V.I.; Arkhipov, O.V.; Krasnykh, A.K.; Rashchevskij, V.P. 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Constructive features of the system of beam injection from the KUTI-20 heavy ion collective accelerator into the TIS heavy-ion synchrotron are considered. The methods for improvement of vacuum conditions in deflectors of the system under consideration are analyzed. The basic circuit of the deflector with supply source is developed. The main feature of the investigated system is that with the purpose of substantial increase of beam intensity it is planned to realize multiple ion injection into the TIS chamber. In total 5 bunches with 20 ms repetition rate are injected. Each subsequent bunch is injected after fast beam spread along the accelerator perimeter. It is shown that as optimal is the version of the deflector with minimum use of ferrite material the contribution of which into the magnetic field level constitutes 2+-0.1. Such deflector ensures the field about 370 Oe with homogeneity +-2% in the aperture 12 x 8 cm. The excitation circuit of the described deflector consists of a driving unit generating at the outlet two pulses of opposite polarity and pulse shaping unit realized on nonlinear lines. The conclusion is drawn that using the described deflector ensures injection efficiency of 0.9 order.

8494 (INIS-SU—352, pp 199-202) **Spiral accelerating systems with equipotential longitudinal electrodes.** Gass, V.F.; Glazkov, A.A.; Krylov, Yu.V.; Leonov, V.N. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Characteristics of spiral accelerating systems with equipotential longitudinal electrodes are studied on models. The considered accelerating system consists of a cylinder formed by flanges and two housing halfs and the resonance system itself. The resonance system consists of two longitudinal electrodes, to which drift tubes and semiwave vibrators, uniformly arranged along the whole accelerating system, are attached in turn. The vibrator ends are attached to longitudinal electrodes, on which a high frequency potential used for particle acceleration is generated. Vibrators are accomplished in a form of spirals with electrodes positioned both outside the spiral and inside it. Structures with stepped and smooth increase of voltage on longitudinal electrodes are studied. Dependences of a ratio of shunt resistance and Q-factor on relative particle velocity and also of resonance frequency and Q-factor on vibrator number are obtained. A conclusion is drawn that the described spiral accelerating system and its modification present a wide choice for designing low-energy ion accelerators.

8495 (INIS-SU—352, pp 244-248) **Testing the system for automated control of a resonator resonance frequency in the mode of preparing for HF-power input using the IYaI AN SSSR benchmark.** Kovalishin, A.S.; Kopin, B.S.; Poltorakov, A.V.; Yamshchikov, G.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Parameter of an on-line system for meson factory linear accelerator resonator resonance frequency control in the resonator bake out and thermostabilization regime are investigated. The change of cooling water flow at the constant temperature is used as a control action in the system. The obtained data analysis shows that the system under consideration provides for the resonator temperature instability of +-0.08 deg C in 6 hours of observation; resonance frequency instability in 2 hours is 0.5 kHz.

8496 (INIS-SU—352, pp 441-443) **SPIN accelerator vaccum chamber.** Alfeev, V.S.; Kovrizhnykh, A.M.; Lobanov, V.I. 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The constructive features of the SPIN ion synchrotron small-aperture vacuum chamber are considered. The advantages of technology used in the course of mounting of the chamber consisting of separate mounting units of 1.5 m length are discussed. The

main feature of the chosen technology consists in the fact that more complicated for realization variant of high-temperature bakeout in the mounted accelerator is substituted by bakceot on a special bench of separate mounting sections while the bakeout on the spot is performed at a lower temperature (up to 350 K). By the present time manufactured and mounted are all elements of the synchrotron vacuum chamber. Its perimeter constitutes 54 m, internal surface - 20 m^2, volume -0.3 m^3. In the chamber the 15 mk Pa presure required for "warm" synchrotron operation without chamber bakeout after mounting is attained. It is expected that after chamber bakeout and its walls cooling up to liquid helium temperature the vacuum below 10^{-9} tor is attained.

8497 (INIS-SU—352, pp 187-190) **Automation of measuring the radiotechnical parameters of accelerating resonators.** Agafonov, S.P.; Godnes, V.V.; Gritsyna, O.Ya.; Kravchuk, L.V.; Romanov, G.V.; Tarasov, S.G.; Sharamentov, S.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The on-line measuring complex used for automation of measuring of accelerating field distribution in resonator length for the meson factory linac is described. The complex provides the measuring of radiotechnical parameters; acquisition, storage, and processing of the available information. The system of probe pulling, electronic frequency meter, data acquisition frequency master osciliator and of resonator frequency tracking device are included into the complex measuring part realizing the method of small distortions. The tracking device is built up on the principle of generator automatic frequency selection self-tuning to the resonator frequency. The computational part consists of the CAMAC modules crate, the SM-4 type computer, display device and printer. The complex control is performed by the display device. This complex is used effectively during the year.

8498 (INIS-SU—352, pp 237-240) **Development of the on-line data acquisition and processing system for the Erevan synchrotron.** Ajrapetyan, B.B.; Tumanyan, A.R. (Erevanskij Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Problems, related to the development of the on-line data acquisition and control system, used at the Erevan synchrotron, are described. The main system development trends are linked with the increase of controlled parameters at the expence of the ES 1011 computer and the RPT80 microcomputer introduction, with autonomous subsystem and control device development on the basis of microprocessor terminals as well as with creating of a number of devices increasing the computer functional capabilities and computerized apparatus application efficiency. The improvements conducted allowed to solve a number of new task, covering the data base formation and its management, periodic measurement and accumulation of data on the accelerator state for a long period; statistic data processing and accelerator probability parameter determination; automatic tracking of current parameter values and registering of deviations beyond the admissible limits as well as refusal registering and accelerator idle time analysis.

8499 (INIS-SU—352, pp 241-243) **Automation of on-line control system equipment performance diagnostics at a meson factory linac.** Gritsyna, O.Ya.; Kiselev, Yu.V.; Zamanskij, G.B. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Test hardware intended for the performance monitoring the meson factory linear accelerator on-line control system specialized equipment is described. Specialized equipment comprises interfaces, input/output devices and synchronization devices. The test hardware considered allows to automate the monitoring process and reduce by more than 4 times the time required for it. Examining of methods used for diagnostics demonstrated their high reliability.

8500 (INIS-SU—352, pp 402-405) **Cylindrical large-aperture lenses with liquid lithium.** Bayanov, B.F.; Vsevolozhskaya, T.A.; Petrov, Yu.N.; Sil'vestrov, G.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The new design of the lithium lens is suggested. Lithium lenses are used for focusing high energy secondary particles. Cardinal change in the lens operation mode is the transition to liquid lithium which is pumped through the lens working volume and heat exchanger. Such lens represents an all-welded titanium construction. Main lens elements are central tube, two welded to it on faces two-wall current lead cylinders and two face flanges with beryllium inserts. Experiments have been conducted using a lens with aperture of 3 cm, thickness of internal tube wall - 3 mm, length - 14 cm. The lens has been supplied with current pulses with amplitude up to 500 kA, pulse duration of 1 ms corresponding to the relation of skin-layer to radius of 0.7 order at liquid lithium resistance of 3 x 10^{-5} Ω xcm. In the course of the experiments the chamber of the electromagnetic pump used for lithium pumping proved to be the most vulnerable element.

8501 (INIS-SU—352, pp 406-409) **High-hertz conical lenses with liquid lithium for low-energy positron focusing.** Bayanov, B.F.; Vsevolozhskaya, T.A.; Danilov, L.L.; Sil'vestrov, G.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Basic characteristics of a short (about 1 cm) lithium lens with field gradient of 100 kOe/cm order being a part of the VLEPP conversion system and intended for focusing positron beam directly behind the target are considered. A lens small length at strong focusing makes insignificant the beam emittance increase for account of particle multiple scattering in the lens substance. The lens represents an all-welded titanium construction with a thin-walled internal tube confining the working volume through which by means of an electromagnetic pump liquid lithium is pumped. It is shown that the conical lens has a number of considerable advantages as compared with the cylindrical one. The main advantage consists in the reduction of the feeding current at the same collection angle and focal distance. The lens for VLEPP 10Hz frequency. The lenses of such type, however, are capable to operate also at 100-200 Hz frequencies.

8502 (INIS-SU—352, pp 415-417) **Stressed state of a cement electrical insulation of a pulsed magnet.** Korenevskij, V.V.; Sugak, E.B.; Fedorenko, L.I. (Moskovskij Inzhenerno-Stroitel'nyj Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The stresses arising in cement electrical insulation of a pulsed magnet intended for separation and scanning of beam of secondary particles with 5-10 MeV energy are investigated during its switching. The magnet represents a single-turn construction. During its switching repulsion forces arise in copper buses which affect the core consisting of a set of iron plates. In its turn two cores trying to separate transmit impact load onto cement electrical insulation, the mechanical strength of which determines the construction durability on the whole. For selection of calculation technique the method of photoelasticity is used on models of transparent polymeric materials. Epoxy resin served as material for insulation model, duraluminium for the rest of magnet parts. It is concluded that the calculation technique for the magnet under investigation is a hingeless circular arc.

8503 (INIS-SU—352, pp 418-424) **Use of cement insulation for development the radiation-resistant pulsed magnets.** Danilov, L.L.; Sil'vestrov, G.I.; Chernyakin, A.D.; Korenevskij, V.V.; Sugak, E.B. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki; Moskovskij Inzhenerno-Stroitel'nyj Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The possibility of using various cement compositions for production insulation of pulsed dipole magnets designed for operation in intense proton beams is investigated. The magnets under consideration are characterized by high values of magnetic field induction (>= 2 T), higher, as compared with permanent magnets, voltage on insulation gaps (of 1 kV order and higher) insulation dynamic load mode necessary lifetime of tens of millions of cycles and high radiation loads by 2-3 orders exceeding the radiation doses permissible for traditional insulation materials. For selection of optimum compositions with high dielectric and physico-mechanical properties 25 compositions based on belitoamominate cement (BAC) and high-alumina cement Talum. The data obtained testify to the fact that the BAC based compositions under normal conditions have higher dielectric properties. In addition, cement insulations possess perfect mechanical properties under dynamic loads. It is concluded that using pulsed magnets with cement insulation turns out advantageous also for usual systems of beam transport.

8504 (INIS-SU—352, pp 178-181) **Studying the superconducting π-type accelerating waveguide.** Vakhrushin, Yu.P.; Ivanov, V.D.; Komkov, A.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Processes of fabrication and testing of a superconducting diaphragmatic waveguide designed for the injector capture section of the LUEhS-5 experimental linac are described. The waveguide is made of the NVCh niobium with a purity of 99.15%. Metal deformation in the process of the electron beam welding of a waveguide results in the π-type oscillation frequency drift of 10.4 MHz. Field monochromatization and simultaneous waveguide tuning on π-type oscillations were carried out by means of chemical polishing technique. The waveguide Q-factor at a temperature of T=4.2 K constitutes 6.6×10^7, at T1.9 K it enlarges up to 1.1×10^8. At T=1.9 K the waveguide withstands the input power of Psub(in)=10 W under continuous conditions and Psub(in)=28 W under pulsed conditions at HF-pulse duration of 20-50 ms and duty factor of 2.

8505 (INIS-SU—352, pp 209-213) **Technique for measuring the field distribution in an initial part channel of the accelerator with HF quadrupole focusing.** Barsukov, A.B.; Belyaev, O.K.; Golosaj, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The automated measuring complex designed for the measurement of the field distribution in the channel of accelerator initial part with HF quadrupole focusing is described. The complex block diagram, its software, and also basic formulae used in measuring results processing and their error evaluation are presented. Profiles of field distribution in accelerating structure length, when using disturbing bodies of different forms, are considered as an example. The complex operates on line with the SM-3 computer. The complete measuring cycle proceeds not longer than 10 minutes.

8506 (INIS-SU—352, pp 214-217) **Superconductivity niobium resonator as a prototype of an accelerating structure cell.** Anashin, V.V.; Bibko, S.I.; Veshcherovich, V.G. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The main parameters of superconducting biperiodic accelerating structure, developed for high energy particle accelerators and storage rings are considered. The results of testing of the two single resonators with the form and dimensions of the considered structure working cell are presented. The resonators are made of sheet niobium with the 4 mm thickness. The first resonator is made of Nb-1 commercial niobium, the second is made of Nb_2-2 pure niobium. The tests conducted have shown, that both resonators Q-factors at T=4.2 K are similar. A long storage under vacuum does not effect the Q-factor. Helium leak-in into the volume leads to the Q-factor decreasing. Training in RF-field allows to increase the pure niobium resonator Q-factor by tw times. The maximum E=4.3 MW/m accelerating field is produced in the pure niobium resonator. In the commercial niobium resonators the limiting fields are twice as low. The conclusion is drawn, that $Q=6.2 \times 10^8$ E=4.3 MW/m values,derived for the pure niobium resonator are close to the design values (E no less than 3 MW/m at $Q=10^9$), provided for the accelerating structure under consideration.

8507 (INIS-SU—352, pp 218-221) **6 MHz accelerating structure with spatially homogeneous quadrupole focusing for heavy ions.** Danil'tsev, E.N.; Dyadin, A.Yu.; Zarubin, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Problems, occurring during the development of the accelerating structure, intended for heavy ion acceleration at the 6.2 MHz frequency in accelerators with spatially homogeneous quadrupole focusing are discussed. The possibility of resonator excitation with the help of lumped inductances, produced in the form of flat or cylindrical spirals is grounded. The possibility of spiral resonance sweep by F-pulses is tested in models with the Q-factor up to 50 proper mechanical frequencies within the range of 3-8 Hz, RF-resonance frequencies of 6-7 MHsub(Z). To eliminate mechanical resonances inductive supports are developed, in which spiral are located in the form of a symmetrical triple star. Using such supports allowed to create accelerating structure section for Bisub(203)sup(+2) ions, beginning with 200 keV energy.

8508 (INIS-SU—352, pp 391-394) **Results of tuning the power supplies for the IHEP booster ring electromagnet.** Vasin, S.V.; Kuznetsov, G.F.; Myaeh, Eh.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The basic circuit and the results of tuning the main power supplies for the IHEP booster ring electromagnet are given. The formation of the required law on changing windings current in the form of unipolar pulses of symmetric shape is realized by means of the capacitor controlled discharge on electric coil of electromagnet windings. Capacitors commutation is realized by thyristor, diode-thyristor keys according to special program. The operation of the power supplies is realized in the pulse burst mode. Each burst comprises from 1 to 30 current pulses. Pulse bursts are followed with Y-70 accelerator cycle. As a result of tuning following power supplies parameters are attained: electromagnet maximum current - 4000 A; injection current - 400 A, acceleration repetition rate - 20 and 16.7 H, pulse duration - 48 and 59 ms; current pulse rise time to injection field level - 2.8 ms; current pulse rise duration - 31 and 34 ms. The power supplies ensured booster commissioning with designed energy of 1.5 GeV.

8509 (INIS-SU—352, pp 395-398) **Kicker magnets for the systems of beam fast commutation in the IHEP proton synchrotron ring injector.** Anikeev, M.A.; Artemov, A.D.; Galkin, B.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Kicker magnets used in the IHEP accelerating facility consisting of a ring injector (booster) and the U-70 proton synchrotron are described. The booster kicker magnets perform several functions. The kicker bump - magnet is used for beam injection into the booster from linear accelerator. Its four sections are located in various ring sections in accordance with the beam betatron oscillations phase and serve for fast orbit perturbation in the course of the injection. Kicker magnets for booster beam extraction and its input into U-70 synchrotron are a part of the beam transport system. The first magnet consisting of 5 sections is located in the booster ring, the second (18 sections) - in the U-70 ring. All kicker magnets have standard structure. The magnet aperture has a rectangular cross section and is formed by magnetic circuit bands of magnetic cores of C-shape and located vertically of direct and reverse buses of the excitation coil. The magnet section has two pairs of coaxial current leads. For magnets power supply generators consisting of shaping lines and high-voltage keys are used. The kicker magnet sections are placed into vacuum boxes.

8510 (INIS-SU—352, pp 231-233) **General structure and organization of the IHEP booster synchrotron on-line control system.** Antipov, V.P.; Balakin, S.I.; Bogatyrev, S.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Structure and organization of data collecting and exchange of the IHEP booster synchrotron on-line control system are described. Booster and control desk technological system servicing is carried out with the help of the MEh-80 microcomputers, produced on the basis of the K580 series microprocessors and the two ES 1010 minicomputers. Minicomputers are responsible for carrying out of main calculation tasks and functions of storing the programs, measured data and their processing results and with servicing of interface with the user. Microcomputers carry out data collection and system parameter monitoring and provide for the system engineering servicing and adjustment from the local terminals. A special working data base is provided for current synchrotron system condition control.

8511 (INIS-SU—352, pp 253-257) **Unified monitors for extracted proton beam diagnostics in the IHEP channels.** Gvakhariya, T.V.; Gres', V.N.; Davydenko, Yu.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Equipment complex, used for extracted beam monitoring at the U-70 synchrotron is described. The main parameters of detectors, used for the beam profile and position, its intensity and loss measurement, as well as of data acquisition and processing system are considered. For the beam profile and position measuring secondary emission multichannel chambers are used. To determine the beam intensity during fast extraction a beam current transformer is used, and as for the slow extraction as secondary emission sealed chamber is used. Beam losses are measured with the use of ionization chambers with geometry close to2π.

8512 **(LBL—21295) Manufacture of keystoned flat superconducting cables for use in SSC [Superconducting Super Collider] dipoles.** Royet, J.; Scanlan, R.M. (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 7p. (CONF-860914—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002561.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

The superconducting magnets used in the construction of particle accelerators are mostly built from flat, multistrand cables with rectangular or keystoned cross sections. In this paper we will emphasize the differences between the techniques for cabling conventional wires for cabling superconducting wires. Concepts for the tooling will be introduced. The effects of cabling parameters on critical current degradation are being evaluated in collaboration with NBS-Boulder.

8513 **(NP—7900272) Considerations on backgrounds at SINQ.** Atchison, F. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). [1984]. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900272.

It is the aim of the study presented to examine what is known about some background precursors expected to be present at the SINQ project that are not found at reactors, and to see their effect on the design of the facility. The possible new effects include a high-energy and a high-energy tail to the neutron spectrum, high energy charged particles, and a high-energy tail to the gamma spectrum. Studies have been restricted to examining the problem of high energy neutrons, particularly as it concerns background at the spectrometers and high-energy neutron fluxes in beam tubes. Reduction of the effect of high energy neutron contamination is considered. (LEW)

8514 **(NP—7900273) The development work at the liquid lead-bismuth target for SINQ.** Takeda, Y.; Gerber, C. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900273.

The design concept for the SINQ target is to use Lead Bismuth Eutectic (LBE) in the liquid phase in a vertical cylindrical container, with the proton beam entering from the bottom. Natural convection of LBE is to be utilized to transport the deposited energy to a heat exchanger at the top. The thermofluid dynamics of this liquid target is one of the important study subjects for a practical design. Numerical calculations were performed to survey effects related to several design parameters. Flow visualization experiments were also made for studying the total flow behavior in a small scale water model.

4304 Storage Rings

8515 (INIS-SU—352, pp 388-390) **Azimuthal heterogeneity of magnetic field pulsation distribution in a ring magnet of the UNK first stage.** Kaz'min, B.V.; Cherepakhin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The specific features of the power supplies of a ring electromagnet of the IHEP accelerating and storage facility (ASF) first stage and their effect on the azimuthal nonuniformity of magnetic field pulsation distribution casising accelerating particles orbit disturbances are considered. The electromagnet under investigation represents the series connection of 2160 dipole magnets and 24 power supply sources connected in magnet spacing. The power supply sources uniformly distributed slong electrical circuit represent thyristor converters (2 kV, 3.5 kA) consisting of two connected in series bridge circuits and rectified voltage pulsations filterso. Basic parameters of dipole magnets: coil inductance - 6.3×10^{-3} H; capacity - 0.11 μF; coil active resistance - 3.4×10^{-3} Ω; loss resistance in parallel equivalent circuit - 150 Ω. It is shown that introduction into the electromagnet circuit of shunting resistors with resistance Rsub(sh)=100 Ω per dipole allows one to reduce the particles closed orbit disturbances up to +-1 mm.

8516 (INIS-SU—352, pp 432-435) **Equipment for magnetic measurements of the UNK dipoles and quadrupoles.** Ivkin, V.G.; Mozin, I.V.; Nikiforovskij, A.V.; Fedorishin, Yu.M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The equipment being a part of automated system intended for measuring homogeneity and nonlinearity of the magnetic field, median planes turn, effective magnets length and magnetic field distribution along longitudinal magnet axes of the accelerating and storage facility is described. The system should ensure measurements with 10^{-5} accuracy. The most complex and labour-consuming are the investigations on homogeneity and nonlinearity of the field. The investigations are performed by harmonic analysis of dependence of radial component of the vector of magnetic field induction on angular coordinate. For measurements the induction transducer representing the system of windings arranged on the surface of two coaxial glass-epoxy tubes is used. The equipment is realized in the CAMAC standard. Data real time control and aquisition is realized by commands of the intellactual controller on-line operated with the microcomputer.

8517 (INIS-SU—352, pp 234-236) **Control system for the SIBIR-1 electron storage ring.** Borovikov, V.M.; Golubenko, Yu.I.; Gudkov, B.A. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

On-line control system structure of the SIBIR-1 booster storage ring which is a part of the storage complex, which serves for generation of the intense synchrotron radiation beams in the range of 0.1-2000 A is described. The system under consideration comprises: 1) two peripheral the "Electronika-60" computers, one of which controls the optical electron channel, the second one-the storage ring; 2) the central SM-4 computer, which provides for the complex operation coordinating as a whole as well as for storing and processing of a large flux of data; 3) control equipment. Control equipment is made in the CAMAC standard. The system software is realized on the basis of multiprogram operational real time RSX-IIM and RSX-IIS systems. Tables of two types, which are stored on the central computer magnetic disks and appear to be the description of the facility and its parts and also the complete description of the complex working regime serve as the basis for the functioning of all the managing programs. All the system equipment and software are made according to the modular principle, which provides for its operation reliability, efficiency restoring and fault diagnostics simplicity.

8518 (INIS-SU—352, pp 249-252) **Application of a 24-digit microcomputer for construction of the VEPP-4 complex distributed control systems.** Aleshaev, A.N.; Belov, S.D.; Levicheva, B.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

In connection with moral and physical ageing of ODRA 1325-ODRA 1305 computers, used in the VEPP-4 control system, a possibility and ways of fully distributed control system creating at this facility are considered. ODRENOK microcomputer which is the CAMAC module, placed into the crate controller position is developed within the framework of these activities. The microcomputer is made on 130 integral circuits and realizes the complete ODRA-1300 computer command set. The main parameters of ODRENOK microcomputer are: mass memory - 64 K of 24 digit words; the average speed is 200-300 thousand operations a second; microprogram operation with a floating point.

8519 (INIS-SU—352, pp 399-401) **Vaccum system for the BEhP storage ring.** Anashin, V.V.; Gil'gengorn, M.S.; Koop, I.A. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The vacuum system of the BEhP storage ring intended for electron and positron injection into the VEPP-2M storage ring as well as for development of the technique for obtaining intense electron beams for injection into VLEPP, is described. Maximum storage ring design energy - 0.7 GeV, beam current - 2 A. The vacuum chamber of elliptical cross section is manufactured of AMsub(ts)C aluminium alloy by the hot pressing method. The chamber pressure constitutes 10^{-6}-10^{-7} Pa and is determined by gas desorption from walls under the synchrotron radiation effect. From the faces the vacuum chamber is terminated by flanges of bimetal - AMsub(ts)C+12Kh18N9T steel alloy performed by explosion welding. The rectilinear gaps are manufactured of 12Kh18N9T steel. In each of them located are a vacion pump and titanium evaporator as well as synchrotron radiation receiver and electrode for chamber surface treatment by glow discharge. The vacuum measurement must be realized by the vacion pump current with data out put through the computer.

8520 (INIS-SU—352, pp 444-448) **Radiation-resistant electrical insulation on the base of cement binders.** Afanas'ev, V.V.; Korenevskij, V.V.; Pisachev, S.Yu. (Moskovskij Inzhenerno-Stroitel'nyj Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The problems of designing radiation-resistant electrical insulations on the base of BATs and Talum cements for the UNK magnets operating under constant and pulse modes are discussed. The data characterizing dielectrical and physico-mechanical properties of 25 various compositions are given. Two variants of manufacturing coils are considered: solid and with the use of asbestos tape impregnated with aluminous cement solution. The data obtained testify to the fact that the advantages of insulation on Talum cement are raised radiation resistance, high strength (particularly compression strength), weak porosity, high elasticity modulus and high thermal conductivity. BATs cement insulation is characterized by high radiation resistance, absence of shrinkage, rather low elasticity modulus and high dielectrical characteristics under normal conditions. The qualities of the solid insulation variant are its high technological effectiveness and posibility to fill up the spaces of complex configuration. In case of using as solid insulation Talum cement, however special measures for moisture removal are required. The advantage of insulation on the base of the asbestos tape is its reliability. For complex configuration magnets, however to realize is such insulation somewhat difficult.

8521 **(KFTI—84-19) Simulation of motion of relativistic electron in a storage-stretcher (RADA code).** Grigor'ev, Yu.N.; Kononenko, S.G.; Mazmanishvili, A.S.; Naugol'nyj, N.N. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1984. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700237.

Problems of simulation of the dynamics of relativistic electrons in a storage-stretcher are considered. Structure of the RADA FORTRAN program and its software are described. Possibility of investigation with this program of the influence of the effect of interconnection of all oscillation types, radiation and fluctuation phenomena on parameters of circulating and extracted electron beams is revealed. Results of the simulation of the process of slow electron extraction from the 2000 MeV storage-stretcher are presented. The obtained results of computer simulation from the electron dynamics are component constituents of works in physical substantiation of positioning of the 2000 MeV NR-2000 storage stretcher at the LUE-2 output. 7 refs.; 7 figs.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 8367, 8369, 8400, 8401, 8402, 8559, 8559, 8670, 8703, 8703, 8720, 8763, 8764

8522 **(AAEC/E—627) Calibration and operation of the AAEC working standard of measurement for the activity of radionuclides. Pt. 1. The measurement system.** Urquhart, D.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700228.

A pressurised 4 π γ ionisation chamber is used by the AAEC as a working standard of measurement for the activity of radionuclides. The instrument has a high degree of stability and the uncertainty in its activity measurements is only marginally greater than that of the primary standards used in its calibration. This report details the method of calibration for a set of known, standardised isotopes, and extends the usage of the ion chamber to other isotopes by an interpolation technique. Particular attention is paid to eliminating changes in calibration due to instrumental variations with time. The measurement system is straight forward in operation, giving best results for γ emitting isotopes with energies above 200 keV and minimum activity of the order of 1 MBq.

8523 **(AAEC/E—630) Calibration and operation of the AAEC working standard of measurement for the activity of radionuclides. Pt. 2. Ion chamber analysis. The measurement system.** Wyllie, H.A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700229.

As a secondary method for the determination of radioactivity, the ion chamber is both convenient and precise. The equations used in the calibration of the equipment and in the calculation of unknown activities are fully derived, and it is shown that the experimental procedure outlined is the optimum for both precision and convenience.

8524 **(CERN-EP—86-143) Experimental techniques.** Sauli, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 2 Oct 1986. 16p. (CONF-860701—57). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900146.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Three main topics are discussed: particle tracking (mostly with gas detectors), particle identification with calorimetry and Cherenkov ring imaging, and some visualization of complex events with optical fibres and imaging chambers.

8525 **(CONF-860520—8) Multiple-angle time-of-flight design concepts. Are we overlooking an order of magnitude in instrument performance for general structural studies.** Jorgensen, J.D. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001569.

From Conference on charged particle optics; Los Alamos, NM, USA (19 May 1986).

It is reported that an optimum resolution function for a time-of-flight powder diffractometer can be achieved by the use of detector banks at multiple scattering angles. The count rate is then raised by using a much narrower band of wavelengths selected by suitable bandpass choppers so that data from different scattering angles overlap. A specific instrument design has been evaluated to illustrate these concepts. It is found that the expected gain in performance is realized, and additional advantages include a lower delayed neutron background and a reduction of systematic errors. Further improvements are mentioned. (LEW)

8526 **(CONF-860520—9) Quantifying powder diffractometer performance. Can we agree on an analytical method for evaluating and comparing instrument performance.** Jorgensen, J.D. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001567.

From Conference on charged particle optics; Los Alamos, NM, USA (19 May 1986).

An overview is given of efforts to evaluate the performance of powder diffractometers. Instrument comparisons made in terms of resolution, count rate, and peak/background ratio are discussed. It is concluded that data from standard samples may offer the best method for comparing instruments. (LEW)

8527 **(CONF-861007—5) Feedback threshold control extends pulse rate measurements into the pileup region.** Valentine, K.H.; Kopp, M.K.; Williams, J.A. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE87002191.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

By using feedback control of the discrimination threshold we have added 4 to 6 decades to the useful range of otherwise conventional pulse counting systems. The additional range is obtained at the high end by retarding saturation of the output count rate with higher threshold levels. We have implemented the method with low-power microcircuits that provide a 9-decade range (10^{-5} to 10^{4} R/h) without the need for range or mode switching.

8528 **(EFI—785(12)-85) Information readout circuit from ionization chambers.** Bagdasaryan, G.A.; Beglaryan, A.S.; Buyukyan, S.P.; Bashindzhagyan, G.L.; Sinev, N.B. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); Erevanskij Fizicheskij Inst. (USSR); Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1985. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700233.

A circuit of the information readout from ionization chambers composed of a linear preamplifier, a logarthmic amplitude-to-digital converter, CAMAC system information storage and extraction is described. The dynamical range of the circuit is 10^{4}. The level of noise at the input is less or equal to 10 V. The number of digits in the binary code is 7. The relative error is 10%. 6 figs.

8529 **(EGG—10282-2097) Pulse filtering for thick mercuric iodide detectors.** Gerrish, V.M.; Williams, D.J.; Beyerle, A.G. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). 1986. Contract AC08-83NV10282. 7p. (CONF-861007—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001782.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

We have investigated a number of electronic pulse filtering techniques for thick mercuric iodide detectors and have achieved improved spectral response for detectors of 1 to 5 mm thickness and gamma ray energies up to 1.5 MeV. Conventional gaussian and gated integration filters were considered as well as more sophisticated filter combinations in order to develop methods of reducing charge measurement errors caused by poor hole collection. When using these techniques, energy resolutions of 3 to 6% and peak-to-valley ratios of 5:1 are common. In this paper we discuss these approaches and present results with thick detectors.

8530 **(GAT-T—3376-Add.1) Contaminant monitor: An improved line recorder: Update report.** Barbarits, F.S. (Goodyear Atomic Corp., Piketon, OH (USA)). 28 Oct 1986. Contract AC05-76OR00001. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002856.

This report is a documentation of the final design/development effort on the Contaminant Monitoring System. During this phase a real-time clock was installed which enabled the automatic chart printing of time and data information. Also software was implemented to support the setting of a separate alarm limit for each

contaminant, and preamplifier gain correction factors were employed to adjust the empirically determined values back to their target values. Finally, non-volatile RAM and electricially programmable read only memories were installed to satisfy the requirement for stand-alone operation.

8531 **(IFVE-FTO—85-42) Position sensitive detector of magnetically charged particles. Proposed experiment.** Ardashev, E.N.; Belokurov, V.N.; Kostrikova, D.N.; Malyev, V.Kh.; Monich, V.A.; Selivanov, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700230.

Two variants of coordinate detectors of magnetically charged paticles based on the utilization of transducers with Josephson transitions are proposed. The system of data acquisition and processing is built up in the CAMAC standard. The helium cryostat diagram is presented. The detector resolution time and dead time constitute 1 μs. Methods of detection of magnetically charged particles used in the above detectors are expected to be more effective, as compared to ionization method and other indirect methods. 56 refs.; 6 figs.

8532 **(IFVE-OEF—85-150) Measurement of coordinates of Cherenkov radiation photons in a wire chamber operating in large current model.** Buzulutskov, A.F.; Vasil'chenko, V.G.; Turchanovich, L.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700231.

Coordinate characteristics of a wire chamber detecting Cherenkov radiation photons have been studied. The chamber working mixture is CH_4-TEA for large current mode. The coordinate along the signal wire was measured by the charge division method, and the transverse one was measured by electron drift time. The space resolution of the detector is 4.5 and 1.5 mm, respectively. A possibility for streamer and Geiger mechanisms to exist simultaneously in the large current mode has been found which has been confirmed by the direct photographing the discharge. 7 refs.; 10 figs.

8533 **(IFVE-ONF—85-72) System of proportional tubes for the Sigma-M spectrometer.** Denisov, D.S.; Musienko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700232.

Submitted to the journal Instrum. Exp. Tech. .

A simple and reliable design of the proportional tube 30 mm in diameter is described. The resolution time of the tube filled with methane is 160 ns the efficiency plateau is more than 1 kV. No change is observed in the operational parameters after total irradiation by 5×10^{10} particles/cm. A method to provide a nonsensitive zone in the tube is proposed. A system comprising 640 tubes is described. The experience proved the simplicty of tuming and high reliability of the proportional tube system. 8 refs.; 4 figs.

8534 (INIS-SU—354, pp 3-7) **Under water measurements of cosmic muons intensities down to a depth of 5 km.** Pustovetov, V.P.; Trubkin, Yu.A.; Fedorov, V.M.; Kirilenkov, A.V. 1984. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780038.

Kratkie Soobshcheniya po Fizike.; (No. 11).

In Plasma physics. Collection.

The results of the experiment on underwater measurements of cosmic muon intensities down to a depth of 5 km performed with a deep-water Cherenkov detector are presented. Within the limits of measurement errors the experimental results are in a good agreement with the calculated curve of cosmic muons absorption in water. 13 refs.; 1 fig.; 2 tabs.

8535 (INIS-SU—354, pp 20-23) **Charged particle detector on the base of microchannel electron multipliers with an emitter of second electrons.** Arvanov, A.N.; Fedorov, V.M. 1984. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780038.

Kratkie Soobshcheniya po Fizike.; (No. 11).

In Plasma physics. Collection.

The characteristics of the detector of fast charged particles on the base of microchannel electron multipliers with a low-density dielctric emitter operating in the control mode by second electrons emission (CSEE) are investigated. Volt-ampere characteristics of emitters with CSEE made from KBr, KCl, MgO, LiF and cryolite are given. The best characteristics are obtained with MgO and cryolite emitters. It is shown that the detector sensitivity can be brought up to 20 electrons per each kiloelectronvolt of particle energy losses. The detector time resolution is by an order less than that of a scintillator based on polystyrene. It is concluded that the given detector can be applied for detecting separate X-ray quanta and plotting on its base a transition radiation counter. Such detector can be used also as a time marker for direct measurements of velocity by passing particles. 5 refs.; 2 figs.

8536 (INIS-SU—361, pp 21-24) **Use of a spectrometer on the base of a diffusion chamber for investigation of micropinch discharge x-radiation.** Veretennikov, V.A.; Krokhin, O.N.; Klyachin, N.A.; Lyapidevskij, V.K.; Semenov, O.G. 1984. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780036.

Kratkie Soobshcheniya po Fizike.; (No. 8).

In Experimental and theoretical physics. Collection.

A spectrometer on the base of a diffusion chamber for investigation of X radiation in the range from 3 to 30 keV was used. Experiments were carried out at the "Micropinch" facility (low-inductive vacuum chamber). Convection type diffusion chamber with a thin sensitive layer (thickness 3 mm, diameter 10 mm) was used. Mixture of air at normal pressure with ethylene alcohol saturated vapours was a working environment. Plasma point transverse size is confirmed independently to be not over than 50 μm. Radiation intensity is sharply increased in a long-wave spectral region 3-6 keV due to Fe ion K-spectral lines. In a more hard (8 keV) part spectral distribution corresponds to reverse exponential dependence on the energy range. 8 refs.; 3 figs.

8537 **(LBL—22182) Role of tracking in future relativistic heavy ion experiments.** Gruhn, C.R. (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 14p. (CONF-860441—9). NTIS MF A01; 2; GPO Dep. File Number DE87001720.

From 5. international conference on ultra-relativistic nucleus-nucleus collisions (Quark Matter '86); Pacific Grove, CA, USA (13 Apr 1986).

Essentially all electronic high energy experiments have used some form of tracking. All of the planned experiments for the CERN SPS RHI program use tracking. In this talk a brief physics justification for tracking is made, emphasizing the need for correlations. Some of the boundary conditions imposed upon tracking for the SPS/RHIC experiments are examined. The CERN experiment NA36 will be used as an example. Some future alternatives which might facilitate tracking in RHI experiments are examined. 5 refs., 5 figs., 2 tabs.

8538 **(NUREG/CR—4743) Neutron dosimetry at commercial nuclear plants: Final report of Subtask D: TEPC [tissue-equivalent proportional counter] feasibility.** Cummings, F.M.; Haggard, D.L.; Endres, G.W.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 41p. (PNL—6014). NTIS, PC A03/MF A01 - GPO. File Number TI87002355.

The feasibility of routinely determining the neutron dose equivalent rates inside commercial nuclear power plants using a microprocessor-controlled, miniaturized tissue-equivalent proportional counter (mini-TEPC) was evaluated during the 1984 and 1985 fiscal years. Two mini-TEPCs, one with a 2-inch- and another with a 5-inch-diameter spherical detector, were tested. The responses of the mini-TEPCs were evaluated for effects resulting from temperature, energy distribution of monoenergetic neutron beams, and broadly distributed energy spectra from moderated sources. In addition, the mini-TEPCs were tested inside the containment of an operating pressurized water reactor. No trends were noted in the response of the mini-TEPCs for monoenergetic (above 200 keV) and broad-beam neutron irradiations. When tested in an environmental cham-

ber and inside containment of a pressurized water reactor, the mini-TEPCs exhibited severe depressions of response as a function of temperature. However, the determination of neutron dose equivalent using the laboratory-scale TEPC was accurate and stable during the temperature study. The response from the mini-TEPC decreased with higher temperature because the temperature affected the built-in electronics and the detector's gas gain. The mini-TEPCs tested in this study did not have mechanisms for adjusting the proton drop point to compensate for the decreased gas gain. It is recommended that the temperature-dependent response problems of the mini-TEPC be rectified before it is used as a neutron-monitoring instrument inside reactor containment.

8539 **(ORNL/TM—10207) Response of a segmented lead glass Cerenkov counter to (1-10 GeV) incident electrons, gamma rays and hadrons.** Gabriel, T.A.; Bishop, B.L. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002971.

The response of a segmented lead glass Cerenkov counter to (1 to 10 GeV) incident electrons, gamma rays and hadrons is studied using the CALOR computer system. The counter is divided into 30 x 30 modules each with a size of 3.5 x 3.5 x 46 cm^3. The calculated quantities include module cross talk, pulse height distributions with and without energy cuts. 7 refs., 5 figs., 9 tabs.

8540 **(ZfK—586) Dubna double-arm time-of-flight spectrometer for heavy-ion reaction products.** Schilling, K.D.; Gippner, P.; Seidel, W.; Stary, F.; Will, E.; Heidel, K.; Lukyanov, S.M.; Penionzhkevich, Yu.E.; Salamatin, V.S.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR); Erevanskij Fizicheskij Inst. (USSR)). May 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700243.

The double-arm time-of-flight spectrometer DEMAS designed for the detection and identification of heavy-ion reaction products at incident energies below 10 MeV/amu is presented. Based on the kinematic coincidence method, the relevant physical information is obtained from the measurement of the two correlated velocity vectors of the binary fragments. Construction and performance of the different detector systems applied to measure the time-of-flight values, the position coordinates and the kinetic energies of both fragments are presented in detail. The description of the data acquisition and analysing procedures is followed by the discussion of some experimental examples to demonstrate the spectrometer performance. A mass resolution of typically 4 - 5 amu (fwhm) is routinely achieved.

8541 **Non-destructive method for determining neutron exposure and constituent concentrations of a body.** Gold, R.; McElroy, W.N. (to Dept. of Energy, Washington, DC). US Patent 4,622,200. 11 Nov 1986. Filed date 22 Feb 1984. v.p.

A portable non-destructive method is described for determination of the neutron exposure to which a selected surface area on a object has been subjected, comprising the following steps: exposing the solid state lithium drifted silicon detector of a Compton Recoil Gamma-Ray Spectrometer to a limited portion of the surface area of the object through a small diameter collimator opening directed toward the surface area; electronically measuring the continuous spectrum of detected gamma-rays at different energy levels during a first traverse of the surface area by the shielded detector; recording a first flux density peak value of the gamma-rays at a selected energy level characteristic of neutron exposure; identifying a first relationship between the first flux density peak value and the spatial activity density value for the measured gamma-rays; modifying the exposure of the detector to the surface area; electronically measuring the continuous spectrum of detected gamma-rays at different energy levels during a second traverse of the surface area by the detector; recording a second flux density peak value of the gamma-rays at the previously selected energy level; identifying a second relationship between the second flux density peak value and the spatial activity density value; solving the first and second relationships to identify the spatial activity density value of the gamma-rays at the characteristic energy level; and subsequently deriving information concerning spatial and angular neutron exposure of the object by known relationships to the identified spatial activity density value.

8542 **Identification of large-transverse-momentum hadrons using a ring-imaging Cherenkov counter.** McCarthy, R.; Adams, M.; Finley, D.; Glass, H.; Jaffe, D.; Kirz, J.; Brown, C.; Jonckheere, A.; Joestlein, H.; Coutrakon, G. (State Univ. of New York, Stony Brook, USA; Fermi National Accelerator Lab., Batavia, IL, USA; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **248**: No. 1, 69-75(15 Jul 1986). (CONF-8407116—).

From Seminar on Cherenkov detectors and their applications in science and technology; Moscow, USSR (11 Jul 1984).

We have constructed and operated a large-aperture ring-imaging Cherenkov counter in a large-transverse experiment at Fermilab. Approximately 3 photons per relativistic particle are emitted in helium gas, focused by spherical mirrors and detected by multistep proportional chambers using a He/TEA gas mixture. Hadron identification is obtained from threshold to approximately 200 GeV/c.

8543 **Simplified x-ray multilayer reflectivity calculations using lossy transmission line theory.** Rockett, P.D.; Lupton, J.H. (KMS Fusion Inc., Ann Arbor, MI 48103). pp 346-353 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Lossy transmission line theory is shown to be a physically meaningful technique for calculating the reflectivity of thin-film multilayer structures with complex indices of refraction. The problem is approached by treating each layer as a transmission line characterized by a given impedance. Reflections are naturally due to impedance mismatches; the impedance is shown to be simply the ratio of the electric and magnetic fields of the plane waves. Both normal and oblique incidence results match conventional calculations, but the transmission line approach requires minimal coding.

8544 **Status of photon counting using solid scintillators.** Heath, R.L. (Idaho National Engineering Lab., Idaho Falls, USA). pp 156-175 of Advances in scintillation counting. McQuarrie, S.A.; Ediss, C.; Wiebe, L.I. (eds.) (Alberta Univ., Edmonton (Canada). Faculty of Pharmacy and Pharmaceutical Sciences). Edmonton, Alberta; University of Alberta (1983). (CONF-830565—).

From Advances in scintillator counting conference; Banff, Alberta, Canada (15 May 1983).

This summary paper presents a review of recent developments in solid scintillation detectors, associated measurement techniques, and apparatus as applied to photon counting. Important advances in scintillator materials, optical sensors, and examples of application of solid scintillators in applied gamma-ray spectrometry are presented as an aid to researchers and applied spectroscopists.

8545 **Interactive modeling of scintillation pulses by visual overlay of computed pulse shapes with the raw data.** Flournoy, J.M.; Lutz, S.S.; Franks, L.A.; Ashford, C.B.; Lyons, P.B. (EG and G, Inc., Santa Barbara, CA, USA; Los Alamos National Lab., NM, USA). pp 219-229 of Advances in scintillation counting. McQuarrie, S.A.; Ediss, C.; Wiebe, L.I. (eds.) (Alberta Univ., Edmonton (Canada). Faculty of Pharmacy and Pharmaceutical Sciences). Edmonton, Alberta; University of Alberta (1983). (CONF-830565—).

From Advances in scintillator counting conference; Banff, Alberta, Canada (15 May 1983).

The modeling technique described in this paper was developed to aid in interpretation of the effects of various changes in scintillator formulations on the shape of scintillation pulses. For example, addition of quenchers to single-solute systems can quench either the solute or excited solvent, or both, and it is useful to understand these effects in tailoring a scintillator for optimum brightness or speed for a specific application. In multisolute scintillators,

an understanding of the detailed energy transfer steps is also desirable. Inspection of pulse rise and decay times often give general information on these effects, but a more detailed interpretation is complicated by several factors. First of all, many scintillators are fast enough (1-2 ns FWHM) so that empirically determined pulse parameters, especially rise times, are significantly affected by the response time of the measuring system. In addition, decay times are difficult to determine until the signal has decayed considerably past the peak where noise can become a problem. It occurred to us that it might be possible to understand the effects of additives on the rise and decay constants that determine the true pulse shape if we synthesized theoretical pulse shapes, folded in the system response function, and overlaid the resulting curves on the raw data arrays. The results have been gratifying in that in most cases it has been possible to distinguish relatively unambiguously between quenching of the solvent and the solute when various heavy-atom quenchers were added to solutions of a series of substituted terphenyls.

8546 **High-Z organic scintillation solution.** Berlman, I.B.; Franks, L.A.; Lutz, S.S.; Flournoy, J.M.; Ashford, C.B.; Lyons, P.B. (EG and G, Inc., Santa Barbara, CA, USA; Los Alamos National Lab., NM, USA). pp 365-375 of Advances in scintillation counting. McQuarrie, S.A.; Ediss, C.; Wiebe, L.I. (eds.) (Alberta Univ., Edmonton (Canada). Faculty of Pharmacy and Pharmaceutical Sciences). Edmonton, Alberta; University of Alberta (1983). (CONF-830565—).

From Advances in scintillator counting conference; Banff, Alberta, Canada (15 May 1983).

In this experiment, an attempt was made to raise the average Z of a scintillation solution with as little attendant quenching as possible. Since high-Z atoms quench by means of a close encounter, as stated above, such encounters are minimized by the use of alkyl groups substituted on the solvent, solute, and heavy atoms. The aromatic compound 1,2,4-trimethylbenzene (pseudocumene) was used as the solvent; 4,4''-di(5-tridecyl)-p-terphenyl as the solute; and tetrabutyltin as the high-Z material. Various experiments were performed with less protected solvents and heavy atoms. These include benzene, toluene, p-terphenyl, bromobutane, and bromobenzene.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 8403, 8576, 8761

8547 **(DPST—86-437) Performance evaluation of Teledyne Geotech bivane.** Addis, R.P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 13 May 1986. Contract AC09-76SR00001. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002651.

The new production prototype bivane manufactured by Teledyne Geotech underwent tests to evaluate its performance and determine its suitability as a replacement for obsolete instrumentation presently on the SRP meteorological towers. The bivane performs well for routine observations for emergency response, as well as for most routine plume dispersion research to be conducted at SRL for the foreseeable future. It should also be suitable for providing an accurate and reliable meteorological data base for engineering and meteorological applications for the next ten years. The bivane was tested in a wind tunnel where its Damping Ratio was found to be 0.30 (azimuth) and 0.29 (elevation), which contrasts with 0.4 claimed by the manufacturer's preliminary specifications. Although the measured damping is less than the optimum value (0.43), it is estimated that the bivane will be able to measure the turbulent parameters (standard deviation of azimuth and elevation) used in the SRP emergency response codes, within 8%. The bivane's suitability as a research tool for measuring turbulent fluxes was determined by comparison with results from a sonic anemometer. The mean bivane momentum flux measurements were within 5% of those of the sonic, averaged over all measured flux intensities, and within 10% of the sonic for fluxes $\leqq$ -0.05 m^2/s^2. During periods of low fluxes, such as may occur under stable nocturnal conditions, a higher damping ratio ($\sim$ 0.4) and a smaller natural wavelength would improve the bivane response to high frequency turbulence. The cup anemometer paired with the bivane, also performed well in the tests. An intercomparison of wind speeds with those measured by the sonic anemometer showed a mean difference of only 1 cm/s (0.02 mph).

8548 (INIS-SU—352, pp 258-259) **Equipment for analog data transmission by optical fiber commutation lines in electrophysical devices.** Gvakhariya, T.V.; Gres', V.N.; Davydenko, Yu.P. 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Two variants of analog signal transmission using optical fiber communication lines are considered. The first, variant is based on luminous flux intensity modulaton, the second one-on puls-width modulation. The methods described may be applied in electrophysical devices, creating a high electromagnetic interference level.

8549 **(KFTI—84-7) Comparative analysis of the spark coordinates' filtration algorithms at the proton track recovery in the carbon polarimeter on the 2 Gev electron linac.** Adushkina, R.I.; Karasev, S.P.; Lyubarskij, G.Ya.; Khazhmuradov, M.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1984. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700235.

Review and classification of different methods of missing of poorly measured points of rectilinear tracks recorded using wire spark chambers are presented. Comparative analysis of quality of separate algorithms and recomendations on their usage are presented. These results are obtained by the methods of simulation and presented in graphs. 9 refs.; 5 figs.; 2 tabs.

8550 **(LBL—22228) Varied-space grazing incidence gratings in high resolution scanning spectrometers.** Hettrick, M.C.; Underwood, J.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 26p. (CONF-860316—12). NTIS, PC A03/MF A01; GPO Dep. File Number DE87002568.

From Topical meeting on short wave length coherent radiation; Monterey, CA, USA (24 Mar 1986).

We discuss the dominant geometrical aberrations of a grazing incidence reflection grating and new techniques which can be used to reduce or eliminate them. Convergent beam geometries and the aberration correction possible with varied groove spacings are each found to improve the spectral resolution and speed of grazing incidence gratings. In combination, these two techniques can result in a high resolution ($\lambda/\Delta\lambda > 10^4$) monochromator or scanning spectrometer with a simple rotational motion for scanning wavelength or selecting the spectral band. 21 refs., 4 figs.

8551 **(UCID—20922) Remote measurement of pressure in shock wave environments using fiber optic sensors.** Haugen, G.R. (Lawrence Livermore National Lab., CA (USA)). 12 Nov 1986. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002930.

A remote optical sensor would have a laser at the monitoring station coupled to an optical fiber which carries its light to an optical material at the fiber tip which returns some of the light back to the other end of the fiber. Design considerations are discussed. A fiber optic system and a pressure sensor have been fabricated. It is proposed to develop an optical remote sensor of pressure and temperature with a rapid response. (DLC)

8552 **(UCRL—95499) Atomic vapor density monitor.** Sewall, N.; Harris, W.; Beeler, R.; Wooldridge, J.; Chen, H.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 5p. (CONF-870119—1). NTIS, PC A02. File Number DE87001356.

From Topical meeting on laser applications to chemical analysis; Incline Village, NV, USA (26 Jan 1987).

This report presents information on the Atomic Vapor Density Monitor (AVDM) system that measures the density of a vapor

by measuring the absorption of light from a swept-wavelength laser that passes through an atomic vapor stream.

8553 **Imaging biological specimens with high-intensity soft x rays.** Solem, J.C. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* 3: No. 11, 1551-1565(Nov 1986).

I compare alternative techniques for x-ray imaging of biological specimens on the basis of (1) transverse and longitudinal resolution, (2) depth of field, (3) choice of recording medium, and (4) recording efficiency. I show that for all imaging techniques, the dosages suffered by specimens are so high that the living state cannot be preserved, nor can the structural integrity of the specimen be maintained in the usual sense. I demonstrate the remarkable fact that, at sufficiently high intensity, an image of diffraction-limited resolution can be captured before the specimen is obliterated.

8554 **Performance of layered synthetic microstructures in monochromator applications in the soft X-ray region.** Pianetta, P.; Redaelli, R.; Barbee, T.W. Jr. (Stanford Synchrotron Radiation Lab., Stanford, CA 94305). pp 393-400 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Wide bandwidth, high throughput monochromators for synchrotron radiation applications have been developed using Layered Synthetic Microstructures (LSM's). A double crystal LSM monochromator has been demonstrated with an energy resolution of 3% at 1.5 keV and a tuning range of 0.8 to 3.5 keV. In addition, techniques for extending the tuning range to lower energies as well as studies of substrate perfection using soft X-ray topography are described.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

8555 **(SAND—86-2127C) Synthesis and properties of polynitrophenyltetrazolatocobalt(III) complexes.** Fronabarger, J.; Johnson, R.; Fleming, W. (Unidynamics, Phoenix, AZ (USA); Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-8610134—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86016117.

From American defense preparedness symposium; Long Beach, CA., USA (27 Oct 1986).

The explosive 3,5-dinitrophenyltetrazolato complex (3,5-DNP) tends to propagate in the deflagration mode which suggests its use as a pressure cartridge charge. However, the existence of 3,5-DNP as a hydrate appears to result in variations of thermomechanical properties thus rendering it undesirable for component use. The 2,4-DNP and 2,4,6-TNP analogs were synthesized. These exist in the anhydrous form under normal conditions and underwent DDT in component configuration. This negated their use in pressure cartridge applications. Synthetic procedures have been developed for 5-(2,4-dinitrophenyl)tetrazole and 5-picryltetrazole as well as for the precursor 2,4-dinitro- and 2,4,6-trinitrobenzonitriles. 6 refs.

4502 Nuclear

8556 **(AD-A—172499/6/XAB) Attacking relocatable targets with the B-1B: a methodology for analyzing the effectiveness of alternative weapons. Master's thesis.** Kline, R.B.; Whaley, G.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Jun 1986. 153p. (AFIT/GST/OS—86M-12). NTIS, PC A08/MF A01.

In this thesis a method was developed to investigate the effectiveness of the B-1B using both conventional and nuclear weapons against a wide range of relocatable targets(RT). An interactive Monte Carlo simulation was developed to model the B-1B sortie from takeoff through target destruction. Emphasis was placed on modeling the major relationships at a macroscopic level. An unclassified analysis of the SRAM, gravity nuclear bomb, conventional and nuclear cruise missile, and the SKEET conventional-sensor-fused weapon against the Soviet SS-20 IRBM was conducted using this method. A single measure of effectiveness, the percentage of RTs destroyed, was employed. Relationships among target dwell time, RT location update time, target hardness, and probability of finding the RT were examined for their impact upon weapon effectiveness.

8557 **(AD-A—172525/8/XAB) Treatise on the measurement of radioactive argon in the atmosphere. Master's thesis.** Runchey, R.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1984. 77p. (AFIT/GNE/PH—84M-13). NTIS, PC A05/MF A01.

A study was carried out to determine the feasibility of using 37Ar and/or 39Ar activity measurements from remote atmospheric samples for monitoring the possible venting of radionuclides from underground nuclear explosions. The study was broken into two parts; 1) a study of the processes for extracting and purifying argon from the remote air samples, and 2) an investigation of the use of mass spectrometry and low-level counting techniques for measuring 37Ar and 39Ar in the purified argon samples. Argon can be extracted from air using a combination of gas-solid chemical reactions and low-temperature gas chromatography. It was found that mass spectrometry cannot be used to measure 39Ar in the atmosphere. At present, low-level internal gas proportional counting is the only feasible means for measuring atmospheric levels of 37Ar and 39Ar. It is concluded that it is not currently feasible to use 37Ar or 39Ar measurements for monitoring purposes. Further studies are needed on radioargon production sources and release rates into the atmosphere.

8558 **(PB—87-100343/XAB) Technologies for NATO's (North Atlantic Treaty Organization) follow-on forces attack (FOFA) concept: a special report of OTA's (Office of Technology Assessment's) assessment on improving NATO's defense response.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1986. 48p. (OTA-ISC—312). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600553.

The report provides an overview of the U.S. technological developments of interest for FOFA. While it does not rate or rank these developments, it does describe what they are and how they might contribute to implementing FOFA. It also provides background on the role of FOFA in NATO strategy, the threat it responds to, and operational concepts for FOFA.

8559 **(UCRL—53724) A survey of nuclear-explosive prompt diagnostics.** Ebert, P.J. (Lawrence Livermore National Lab., CA (USA)). 25 Mar 1986. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002738.

Nuclear-explosive prompt diagnostics techniques and equipment are surveyed. These techniques and equipment have been developed to answer nuclear-explosive performance questions. The techniques and equipment must be selective in radiation sensitivity, linear in calibration, fast, insensitive to strong signals, wide in dynamic range, and reliable. Diagnostic techniques and equipment measure neutron, gamma-ray, and x-ray emissions, as well as aid in the determination of the physical location of the production of radiation through imaging. The high cost of nuclear experiments will continue to encourage the development of sophisticated techniques to gain as much information as possible from each experiment.

4503 Explosion Detection

8560 **(UCID—20891) North American geophysical analogs to the USSR: implications for siting seismic verification stations.** Sweeney, J.J.; Harben, P.; Harris, D. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002367.

We compare large-scale geophysical and geological characteristics of North America and the USSR to identify places in North America to site seismic stations that can provide analogs to seismic propagation conditions in the USSR. Precambrian crystalline rock (continental shield) is exposed in only a small percentage of the total area of the USSR, while a large proportion of the area consists of Paleozoic sediments overlying crystalline basement. We think that the Great Plains area of North America, which is underlain by Paleozoic and younger sediments lying on crystalline basement, provides the best analog to large areas of the USSR for seismic propagation studies. We suggest that the area of Kansas-Oklahoma-Missouri be investigated as the site for the next seismic array deployment for verification studies.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

8561 **(ECN—86-059) Interim report of the Working Group 'Air' of the Coordination Commission 'Research project on acidification'. Activities, January-November 1985; first and second phase of the project.** Ten Brink, H.M.; De Leeuw, F.A.; Asman, W.A.; Duijm, N.J.; Van Aalst, R.M.; Van Egmond, N.D. (Netherlands Energy Research Foundation, Petten). Apr 1986. 28p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The task of the commission is to develop a model which describes the acidification process from emission up to and including effects. This model will serve as help in evaluating abatement measures. In the first phase a simple model has been developed to demonstrate the possibilities of the set-up by connecting the different submodels or modules. For the most important components, sulfur dioxide, nitrogen oxides and ammonia, the distribution modules for the demonstration model became available. In the second phase data were collected with respect to distribution and deposition in order to define the distribution module of the definitive model. Some constraints are described. 11 refs.

8562 **(ECN—86-127) A fog chamber and wind tunnel facility for calibration of cloud water collectors.** Mallant, R.K. (Netherlands Energy Research Foundation, Petten). Sep 1986. 24p. (CONF-8609193—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From NATO advanced research workshop on acid deposition processes at high elevation sites; Edinburgh, UK (8 Sep 1986).

The interest in cloud water chemistry and the role of intercepted cloud water in forest die-back has led to the construction and use of various droplet collectors. Most of these collectors have not been calibrated adequately. A facility for testing of cloud and fog water collectors is described. Water droplets of known composition and size are used in the calibration process. To overcome errors due to evaporation of the droplets after generation, the air is pre-humidified and thermostated. By using different types of generators, various polydisperse droplet spectra can be obtained. 3 figs., 1 tab., 26 refs.

8563 **(UCRL—94702) Use of optical cross-wind sensors and tethersondes for mass flux measurements in valleys.** Porch, W.M. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 12p. (CONF-870128—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000532.

From 6. symposium on meteorological observations and instrumentation; New Orleans, LA, USA (12 Jan 1987).

The details of cold air mass flux in valleys during nocturnal drainage conditions are poorly understood. These details include the relative contributions of valley sidewalls, tributaries, and mid-valley subsidence to the cold air flow. The Department of Energy's Atmospheric Studies in Complex Terrain (ASCOT) project focused a field study supported by numerical model studies on cold air flux in a deep valley in the oil shale region of Western Colorado (Budiksen et al., 1984). The results presented here represent a small part of this study which included over ten other Laboratories and several Universities. Our work concentrated on the application of path averaging optical cross-wind sensors to this study. These instruments measure an optically weighted average wind speed component perpendicular to the optical path. Figure 1 shows the deployment geometry of 13 of these instruments in and across Brush Creek Valley in September and October 1984. These paths were chosen to study the variation of drainage flow in the main valley, the flow down the main valley sidewalls, flow out of one of the larger tributaries and the intrusion of synoptic wind into the top of the valley.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 7889, 7896, 7897, 8301, 8359, 8467, 8561, 8562, 8580, 8582, 8583, 8601, 8626, 8627, 8628, 8629, 8630, 8631, 8632, 8633, 8634, 8635, 8636, 8637, 8638, 8639, 8640, 8642, 8643, 8644

8564 **(BNL—38705) Analysis of precipitation chemistry data in the New York City and surrounding region.** Dupuis, L. (Brookhaven National Lab., Upton, NY (USA)). Apr 1986. Contract AC02-76CH00016. 20p. NTIS, PC A02. File Number DE87002395.

Analysis of three years of precipitation chemistry data in the New York City metropolitan region, and two years of data from surrounding NADP and MAP3S sites has indicated an urban excess in concentration and deposition for H^+, SO_4^{2-} and Ca^{++}. Urban levels were found to be on the order of 20 to 40% higher than values measured for locations ranging from 15 to 60 km outside of the city, and as much as 40 to over 150% higher than levels measured at locations beyond 80 km (background or regional values). The urban perturbations are most pronounced during the winter season, largely reflecting the local influence of residential and commercial space heating usage, and in some cases virtually non-existent during the summertime. Time series analysis shows a decrease in urban acidity levels since the late 1970's, although the decline is not as pronounced during the latter portion of the 1978-1983 period. No significant trends were found for the surrounding locations, except for Ca^{++}. Urban pollutant levels (SO_2, NO/sub x/, TSP) were also higher than surrounding locations. A similar decreasing trend was found in Manhattan since 1979, but air quality levels seem to have levelled off in the last two years of record (1982-1983). In terms of the 85 Assessment, this analysis reveals that use of regional values of wet H^+ deposition underestimates the urban, local impact on materials damage. The value for New York City as interpolated from regional values was on the order of about 47 mg/m^2, while annual deposition actually measured in Manhattan is nearly two times that level (85 mg/m^2), a level that is equivalent to what is measured in the Ohio River Valley.

8565 **(BNL—38776) PRECP: the Department of Energy's program on the nonlinearity of acid precipitation processes.** Tanner, R.L.; Tichler, J.; Brown, R.; Davis, W.; Johnson, S.; Patrinos, A.A.N.; Sisterson, D.; Slinn, W.G.N. (Brookhaven National Lab., Upton, NY (USA); Pacific Northwest Lab., Richland, WA (USA); Argonne National Lab., IL (USA)). Sep 1986. Contract AC02-76CH00016. 182p. NTIS, PC A09. File Number DE87002147.

During the period of 1 April to 3 May 1985, staff from Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), and Pacific Northwest Laboratory (PNL), participated in a multifaceted, coordinated set of field studies from an aircraft logistical base in Columbus, OH, and a surface precipitation and air chemistry network in the Philadelphia area. The general goals of these activities, conducted within the DOE-sponsored PRocessing of Emissions by Clouds and Precipitation (PRECP) program were to obtain information concerning scavenging ratios and the vertical distribution of cloud and precipitation chemistry for sulfur and nitrogen oxides and oxyacids, and for oxidant species in the vicinity of precipitating and nonprecipitating clouds. Profiling of pollutant concentrations and phase distributions, and studies of scavenging processes were accomplished principally by airborne measurements of aerosol and gaseous species in pre-cloud and below-cloud air and of aqueous-phase species in clouds and precipitation, accompanied by documentation of meteorological and cloud physics parameters in the sampled regimes. Studies in the Midwest utilized only limited surface precipitation collection and chemical measurements, where-

as a more extensive ground precipitation network was deployed in the Philadelphia area studies together with surface air chemistry measurements at a single nonurban site.

8566 **(BNL—52013) Computer-assisted study of the kinetics of H_2O_2-S(IV) reaction in precipitation samples.** Shen, J.; Lee, Y.N. (Brookhaven National Lab., Upton, NY (USA)). Jul 1986. Contract AC02-76CH00016. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002743.

A computer-assisted data acquisition and analysis method for the study of the kinetics of H_2O_2-S(IV) reaction in precipitation samples has been developed. The extent of reaction was followed by continuous amperometric measurement of the concentrations of the reagents. The analog output signal of the amperometric device was acquired, digitized, and processed by a Keithley DAS Series 500 data acquisition system connected to an IBM-PC/XT computer. The apparent second-order rate constant of the reaction, as defined -d[H_2O_2]/dt = k/sup (2)/[H_2O_2][S(IV)], was calculated by the computer using a least-squares fitting routine. This technique was found to be applicable for a wide range of pH and concentrations of H_2O_2 and S(IV) as exhibited by precipitation samples. A comparison of the results obtained by this method and a manual method revealed that the computer-assisted method not only was more time efficient but also yielded data with higher precision.

8567 **(DOE/NV/10384—01) Daily, seasonal, and annual precipitation at the Nevada Test Site, Nevada.** French, R.H. (Nevada Univ., Las Vegas (USA). Water Resources Center). Sep 1986. Contract AC08-85NV10384. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002474.

A comprehensive understanding of the temporal and spatial distribution of precipitation is crucial from the viewpoint of understanding the hydrologic cycle. In this report, the daily precipitation data base which has been digitized from the raw data available for the Nevada Test Site and a program which can be used to interrogate this data base are discussed. The daily precipitation data base includes all data for the period 1957 - 1985 inclusive. In addition, this report discusses several methods to use the precipitation data available at gaged locations to estimate the precipitation at ungaged locations on daily, seasonal, and annual time scales. Finally, a number of conclusions and recommendations regarding precipitation data for the Nevada Test Site are stated. Among these conclusions are recommendations that before any of fifteen precipitation stations with long and reliable periods of record are discontinued careful consideration be given to the impact of such an action. It is also noted that the western area of the Nevada Test Site has inadequate precipitation gage coverage.

8568 **(DOE/PETC/TR—87/2) Review summary of stack sampling of fine particulates.** Pan, Y.S. (USDOE Pittsburgh Energy Technology Center, PA). Oct 1986. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002511.

In this report, twenty-eight different techniques of sampling particulates emitted from the stacks of stationary sources are reviewed and summarized. These include the standard methods for determining particulate mass emissions in compliance with standards of performance; methods for sampling size-fractionated particulates for determining their physical, chemical, and biological characteristics; and methods for measuring efficiencies of particulate control devices. In-stack and out-of-stack techniques, without and with dilution systems, are included.

8569 **(GSF-BPT—1/86) NO_2 conversion during atmospheric propagation of NOsub(x).** Knoche, K.F.; Richard, H.G.; Schneider, F.; Janicka, J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften; Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Technische Thermodynamik und Inst. fuer Thermodynamik). 1986. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750297.

A numerical model of NOsub(x) dispersion and reaction in the exhaust plumes of point sources is developed which takes account of the following mechanisms in the plume: Turbulent dispersion of NOsub(x), chemical reactions of NO/NO_2 conversion; effects of turbulence variations on the chemical reactions.

8570 **(GSF-BPT—3/86) Investigation of the chemical decomposition of atmospheric NOsub(x). Final report.** Drummond, J.; Ehhalt, D.H.; Huebler, G.; Johnen, F.J.; Junkermann, W.; Kessler, C.; Khedim, A.; Kins, L.; Meixner, F.; Mihelcic, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie). 1986. 238p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87750302.

Concentrations of hydroxyl radicals and nitric oxides were recorded in three extensive measuring campaigns. Further, other parameters were measured in order to determine the mechanism of NOsub(x) decomposition as related to the model calculations. A comparison between model values and measured values showed that the OH concentration was overestimated by the model. Most probably, this is due to unknown mechanisms of radicals loss. Formation of HNO_3 in the atmosphere may accelerate smog development; for this reason, the chemistry of HNO_3 was investigated in detail. Measurements on the major sources of NOsub(x) (motor cars and industrial furnaces) showed that the contribution of direct emissions to the atmospheric HNO_3 balance is not significant.

8571 **(NP—7750296) Investigations into the reaction of sulfur dioxide with hydroxyl-radicals and the reaction of sulfur trioxide with trace gases of the atmosphere.** Becker, K.H.; Wirtz, K. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.)). Oct 1985. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750296.

The rate constant for the reaction of SO_3 with OH radicals at a total pressure of 700 torr was determined in air. Because SO_3 is very likely an intermediate of the reaction of SO_2+OH+O_2 also rate constants for the reaction of SO_3 with the gases H_2O, CH_4, CO, C_2H_6, CH_3OH, CH_3SH, H_2S, NO_2, NO and NH_3, were measured using a flow tube.

8572 **(ORNL/TM—9867) Modeling and testing of formaldehyde emission characteristics of pressed-wood products: Report XVIII to the US Consumer Product Safety Commission 1985.** Matthews, T.G. (Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002326.

The experimental results and modeling of a second environmental chamber study of the environmental dependence of CH_2O emissions from selected pressed-wood products are reported. Results for particleboard underlayment, hardwood plywood paneling, and medium denity fiberboard are given. Revised models for (1) variation in CH_2O concentration inside a single compartment with a single emitter (i.e., Model I), and (2) variation of CH_20 emission rate of a single emitter (Model II) as a function of environmental parameters are presented. The revised models include a (1) a linear function for the temperature (T) and relative humidity (RH) dependence of the CH_2O transport rate through the bulk phase (i.e., board) and (2) a non-linear function for the RH dependence of the CH_2O concentration in the bulk phase. Pressed-wood product emissions data from individual Study II boards and the combined data sets from Environmental Parameters Studies I and II are analyzed using the revised models.

8573 **(PB—87-100046/XAB) Interactive computer model for calculating V-I curves in ESPs (electrostatic precipitators): Version 1.0. Report for July 1984-July 1986.** Lawless, P.; Sparks, L.E. (Research Triangle Inst., Durham, NC (USA)). Sep 1986. 207p. NTIS, PC A10/MF A01.

The manual describes two microcomputer programs written to estimate the performance of electrostatic precipitators (ESPs): the first, to estimate the electrical conditions for round discharge electrodes in the ESP; and the second, a modification of the EPA/SRI ESP model, to estimate the particle-collection efficiency of the ESP operating with the electrical conditions predicted by the first program. Both programs, written in the BASIC computer language, are designed for the IBM-PC and compatible computers and the Tandy 2000 computer. The programs require Advanced BASIC and a color-graphics adapter. The V-I program allows prediction of electrical conditions for both positive and negative corona and for

arbitrary discharge-electrode diameters and wire-to-wire spacing. This means that most commercial discharge-electrode geometries can be simulated by proper selection of wire diameters and spacing. Both the V-I and performance models are completely documented in the report, including a discussion of the theory on which the models are based.

8574 **(PB—87-100533/XAB) Air-pollution impacts when quenching blast furnace slag with contaminated water. Final report, December 1983-April 1984.** Annamraju, G.; Schworer, P.J. (PEI Associates, Inc., Cincinnati, OH (USA)). Sep 1986. 59p. NTIS, PC A04/MF A01.

The report gives results of an effort to determine if a potential alternative to treatment prior to discharge of coke-plant wastewater will result in a significant increase in emissions to the atmosphere. The alternative is using the wastewater, untreated, to quench blast-furnace slag. To develop a preliminary determination, six emission measurements were made on a laboratory-scale facility simulating typical slag-quenching practice. Test parameters encompassed two slag temperatures (594 and 816 C) and two waters, ASTM Type 1 water and coke-plant effluent diluted to 2500 mg/liter TDS. Results indicate that particulate emissions increase with slag temperature and TDS in the water. Minor quantities of organic compounds were emitted, but showed no correlation with test variables. The data also showed no correlation between emissions of sulfur dioxide or fluoride and test variables.

8575 **(PB—87-101234/XAB) Destruction of chlorinated hydrocarbons by catalytic oxidation. Final report, August 1985-July 1986.** Palazzolo, M.A.; Jamgochian, C.L.; Steinmetz, J.I.; Lewis, D.L. (Radian Corp., Research Triangle Park, NC (USA)). Sep 1986. 154p. (RAD—86-203-023-34-11). NTIS, PC A08/MF A01.

The report gives results of a determination of the effectiveness of catalytic oxidation for destroying vapor-phase chlorinated hydrocarbons. The study was conducted on two pilot-scale catalytic incinerators: one employed a metal oxide catalyst in a fluidized-bed configuration; and the other, a fixed-bed proprietary catalyst, supplemented with ultraviolet (UV) light and ozone injection. Both systems were tested under a variety of temperature and space velocities. The test vapor streams consisted of low concentrations (3-200 ppmv) of mixtures of organic compounds, and included three streams that represented emissions from air strippers used to treat contaminated groundwater at U.S. Air Force bases. Study results showed that the fluidized-bed catalytic incinerator was capable of achieving total organic destruction efficiencies of greater than 98%. The UV/ozone catalytic incinerator failed to achieve high destruction efficiencies: with ozone injection, total destruction was 75%; and without ozone, the maximum destruction efficiency was 64%.

8576 **(PB—87-102331/XAB) Instrumental monitoring of non-methane hydrocarbons at a hazardous-waste incinerator.** Menzies, K.T.; Adams, J.W. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Sep 1986. 92p. (ADL—85274-04). NTIS, PC A05/MF A01.

The objective of the field program was to evaluate the reliability of non-methane hydrocarbon analyzers as a continuous indicator of DRE of a hazardous-waste incinerator. The tasks undertaken include: (1) fabrication of a sample extraction/conditioning system for transfer of combustion gas to the hydrocarbon analyzers; (2) evaluation of the reliability of two non-methane hydrocarbon analyzers under conditions of continuous operation at a hazardous-waste incinerator; and (3) determination of the correlation of non-methane hydrocarbon concentrations with combustion efficiency. During a 5-day test, two non-methane hydrocarbon analyzers (Columbia Scientific Industries Corporation Model 500-2E and HNU Systems, Inc. Model 201-250) were evaluated. During the tests, the sample conditioing/analysis system operated reasonable well.

8577 **(PB—87-102364/XAB) Interim user's guide to the RADM scavenging Module Version 1.0. Interim report.** Berkowitz, C.M.; Easter, R.C. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. 103p. NTIS, PC A06/MF A01.

The report is an interim version of the user's manual for the RADM Scavenging Module (RSM). The scavenging module simulates wet removal and aqueous-phase chemical processes as they occur on a regional scale. It is designed for inclusion into a regional-scale Eulerian code that does not explicitly account for processes involving clouds and precipitation. Using surface precipitation rates and vertical profiles of temperature and moisture for a regional-scale grid square, the scavenging module calculates steady-state cloud, precipitation, and vertical velocity fields for subgrid areas representing stratiform, convective, and fair-weather cumulus clouds. It then calculates the effects of aqueous-phase chemistry, precipitation scavenging, and transport on the pollutant fields presented by the host code for a specified time period (one hour). The version of the RSM described in this report includes the stratiform and convective storm component; it does not include the fair-weather cumulus (although provisions for including this component are outlined). A description of several proposed benchmark tests is provided; the results of these tests will be published in future reports.

8578 **(PB—87-102372/XAB) Evaluation of the efficiency of industrial flares: H_2S gas mixtures and pilot-assisted flares. Final report, April 1985-July 1986.** Pohl, J.H.; Soelberg, N.R. (Energy and Environmental Research Corp., Irvine, CA (USA)). Sep 1986. 105p. NTIS, PC A06/MF A01.

The report is the fourth in a series on a research program that will result in quantification of emissions from, and efficiencies of, industrial flares. The report gives test data on the combustion efficiency and destruction efficiency of (1) gas mixtures containing H_2S, and (2) flare flames with pilot-flame stabiliztion. The latest tests, conducted on 3- and 6-in. open pipe flares without aerodynamic flame-stabilization devices, led to conclusions including: (1) gas mixtures of H_2S/N_2 can be stably flared at much lower volumetric gas heating values than can propane/N_2 mixtures; (2) destruction and combustion efficiencies greater than 98% are obtained for gas mixtures of H_2S/N_2 and H_2S/propane/N_2 when the gas-heating value is at least 1.4 times the level required to produce a stable flame; (3) for mixtures containing both H_2S and propane, H_2S destruction efficiency was consistently higher than propane combustion efficiency; and (4) combustion efficiencies greater than 98% for pilot-assisted flares are achieved when the heating value is greater than 1.2 times that required to stabilize the flame.

8579 **(PB—87-103628/XAB) Lime and cement industry particulate emissions: source category report. Volume 1. Lime industry. Final report, June 1984-July 1986.** Kinsey, J.S. (Midwest Research Inst., Kansas City, MO (USA)). Sep 1986. 280p. NTIS, PC A13/MF A01.

The report gives results of a study to develop particulate emission factors based on cutoff size for inhalable particles for the lime industry. After reviewing available information characterizing particulate emissions from lime plants, the data were summarized and rated in terms of reliability. Size-specific emission factors were developed from these data for the major processes used in the manufacture of lime. A detailed process description was presented with emphasis on factors affecting the generation of emissions. A replacement for Section 8.15 (Lime Manufacturing) of EPA report AP-42, Compilation of Air Pollutant Emissions Factors, was prepared, containing the size-specific emission factors developed during this program.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 8557

5006 Regulations

REFER ALSO TO CITATION(S) 8156, 8157, 8470, 8471, 8602, 8626

8580 **(ORNL/TM—9818) Biological vulnerabilities of National Park Service Class I areas to atmospheric pollutants: Environmental Sciences Division publication No. 2646.** Esserlieu, M.K.; Olson, R.J. (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002964.

The National Park Service (NPS) is responsible for managing 322 parks and other lands; 48 of the parks are designated as "Class I" areas under the requirements for prevention of significant deterioration (PSD) of the Clean Air Act. This designation is intended to protect the parks from sulfur dioxide (SO_2) and suspended particulates. Nonetheless, long-range transport of these and other pollutants, particularly ozone (O_3) and acidic deposition, potentially threatens the health and structure of ecosystems of these 48 Class I parks. This analysis quantifies and ranks their sensitivities to air pollutants; it also estimates relative risk to aid determination of priorities for monitoring and for more detailed analyses. Vulnerability was assessed by determining from literature sources the sensitivity of the dominant vascular plant species to SO_2 and O_3 and the sensitivity of lichens to SO_2. The additional sensitivity factor of surface water alkalinity was included to indicate potential vulnerability to acidic deposition. When these factors were compared with ambient air quality, the risks for potential impacts to these Class I parks were estimated.

8581 **(PB—87-107769/XAB) Resource Conservation and Recovery Act (RCRA) facility assessment guidance.** Rastatter, C.; Fagan, D.; Foss, D. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Oct 1986. 176p. (EPA—530/SW-86/053). NTIS, PC A09/MF A01.

Facilities that manage hazardous wastes are required to obtain permits under the Resource Conservation and Recovery Act (RCRA) of 1976. This guidance document informs RCRA permit writers and enforcement officials of procedures to be used in conducting RCRA Facility Assessments. The RCRA corrective-action program was established to investigate and require clean up of releases of hazardous wastes or constituents to the environment at facilities subject to RCRA permits. Releases to ground water, surface water, air, soil, and subsurface strata may be addressed.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 8104, 8561, 8562

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 8301, 8561, 8562

8582 (KFK-PEF—4-Vol.1, pp 43-54) **Reference data on forest growth (firs and spruces) in Baden-Wuerttemberg.** Kenk, G. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Growth studies of damaged trees and stands gave very different results. Norway spruce with remarkable needle loss has often no significant increment reaction. The interpretation of measurement results leads to questions of 'normal' growth. Same proposals are discussed. If growth is understood as a measureable expression of the sites and ecosystems quality differences between development of actual and foregoing stand could give informations about dimension and direction of changes. Negative development could be damage in growth. Investigation about measurable changes is a task of the project 'reference data to forest growth'. Actually data collecting and processing is in realization.

8583 (KFK-PEF—4-Vol.1, pp 275-285) **Precipitation input of atmospheric pollutants in forest soils 1982 to 1985.** Evers, F.H. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

In different forest areas of Southwest Germany samples of crown throughfall in coniferous and deciduous woods and samples of the precipitation in neighboured open areas had been analysed for several years (1982-1985). In this way the sites classified according air-borne input characteristics. pH-values show clearly the range of total acid load. Their annual mean values do not show great variations. In contrast to this, the input of atmospheric pollutants depends to a high degree on the amount of annual precipitation. The input data presented must be correlated with meteorological site characteristics and with the turnover in soils and trees. Moreover, they may serve as a base for comparisons with the situation of atmospheric pollutant input in other forest areas of middle Europe.

8584 (KFK-PEF—4-Vol.1, pp 287-299) **Aspects of the chemical microcompartimentation in forest soils.** Hildebrand, E.E. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

A new arrangement for the percolation of undisturbed soil cores has been developped. Thereby it can be shown, that in forest soils exist chemical desequilibria between the surfaces of aggregates and the bulk soil. The surfaces of aggregates, which are mainly in contact with soil water of low water tension, show more intensive soil acidity parameters. When soil acidity characteristics are derived from bulk soil analysis, the loss of information, caused by the removal of chemical desequilibria, must be taken into consideration. The same is valid, if results from soil analysis are used to predict benefits or risks of forest fertilization practices. Examples of application demonstrate the scale, variation and the ecological importance of chemical desequilibria in forest soils.

8585 (KFK-PEF—4-Vol.1, pp 353-357) **Litter decomposition and litter decomposing soil microfauna in forest ecosystems.** Herlitzius, H.; Bernhard, M.; Borin, A.; Funke, W.; Jans, W. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Concentrations of 23 elements had been determined by instrumental neutron activation analysis and ICP-atomemissionspectroscopy in living and dead plant material and in various arthropods of a spruce stand nearby Ulm (Swabian Alb). The heavy metals Cu, Mo, Cd, Hg, Cr, Sb, Se and Zn were accumulated by certain arthropods. This is proved true especially for rhizophagous and detritophagous animals and to a limited extent for needle-eaters, sap-suckers and zoophagous arthropods of the groundfloor. Concentration factors (ppm in animal/ppm in diet) differ in relation to the trophic level the species belong to and within a trophic level, the accumulation of elements is species-specific.

8586 **(PB—87-100582/XAB) Characterization of chemical-waste-site contamination and determination of its extent using bioassays.** Thomas, J.M.; Skalski, J.R.; Cline, J.F.; McShane, M.C.; Miller, W.E. (Pacific Northwest Lab., Richland, WA (USA)). 1986. 17p. NTIS, PC A02/MF A01.

The purpose of using bioassays to evaluate soils, soil elutriates, and surface and subsurface water from hazardous chemical waste sites is to provide a more-direct, integrated estimate of environmental toxicity. Based on bioassay data, chemical waste sites can be ranked according to their toxic potential or mapped for cleanup operations. The objectives of the study were to (a) assess the comparative sensitivity of test organisms to known chemicals, (b) determine if the chemical components in field soil and water samples of unknown composition could be inferred from laboratory studies using pure chemicals and (c) investigate kriging (a relatively new statistical mapping technique) of bioassay results as a method to define the areal extent of contamination. In support of these objectives, data are presented on the response of the organisms listed in the Hazardous Materials Assessment Team (HMAT) test protocol

(3) to pure chemicals from three chemical subgroups (heavy metals, insecticides, and herbicides).

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 8593

8587 (EGG—10282-1124) History of aerial surveys in response to radiological incidents and accidents. Jobst, J.E. (EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Aerial Measurements Operations). 1986. Contract AC08-83NV10282. 6p. (CONF-8609147—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001788.

From American Nuclear Society annual meeting; Bethesda, MD, USA (15 Sep 1986).

EG and G Energy Measurements Inc., operates the Remote Sensing Laboratory for the US Department of Energy (DOE). The Laboratory plays a key role in the federal response to a radiological incident or accident. It assists the DOE in the establishment of a Federal Radiological Monitoring and Assessment Center (FRMAC). The Remote Sensing Laboratory has played a major role in more than 13 incidents, including lost sources, accidental dispersions, and nuclear reactor incidents.

8588 (ORNL/M—155) 1986 annual information meeting. Abstracts. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 28p. (CONF-8605183—Absts.). NTIS, PC A03/MF A01; GPO Dep. File Number DE86014930.

From Environmental Sciences Division annual information meeting; Oak Ridge, TN, USA (7 May 1986).

Abstracts are presented for the following papers: Geohydrological Research at the Y-12 Plant (C.S. Haase); Ecological Impacts of Waste Disposal Operations in Bear Creek Valley Near the Y-12 Plant (J.M. Loar); Finite Element Simulation of Subsurface Contaminant Transport: Logistic Difficulties in Handling Large Field Problems (G.T. Yeh); Dynamic Compaction of a Radioactive Waste Burial Trench (B.P. Spalding); Comparative Evaluation of Potential Sites for a High-Level Radioactive Waste Repository (E.D. Smith); Changing Priorities in Environmental Assessment and Environmental Compliance (R.M. Reed); Ecology, Ecotoxicology, and Ecological Risk Assessment (L.W. Barnthouse); Theory and Practice in Uncertainty Analysis from Ten Years of Practice (R.H. Gardner); Modeling Landscape Effects of Forest Decline (V.H. Dale); Soil Nitrogen and the Global Carbon Cycle (W.M. Post); Maximizing Wood Energy Production in Short-Rotation Plantations: Effect of Initial Spacing and Rotation Length (L.L. Wright); and Ecological Communities and Processes in Woodland Streams Exhibit Both Direct and Indirect Effects of Acidification (J.W. Elwood).

8589 (ORNL/TM—10076) Results of radiological measurements taken in the Niagara Falls, New York, area (NF002). Williams, J.K.; Berven, B.A. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002963.

The results of a radiological survey of 100 elevated gamma radiation anomalies in the Niagara Falls, New York, area are presented. These radiation anomalies were identified by a mobile gamma scanning survey during the period October 3-16, 1984, and were recommended for an onsite survey to determine if the elevated levels of radiation may be related to the transportation of radioactive waste material to the Lake Ontario Ordnance Works for storage. In this survey, radiological measurements included outdoor gamma exposure rates at 1 m above the surface; outdoor gamma exposure rates at the surface, range of gamma exposure rates during scan; and uranium, radium, and thorium concentrations in biased surface soil samples. The results show 38 anomalies (35 located along Pletcher Road and 3 associated with other unreleated locations) were found to exceed Formerly Utilized Sites Remedial Action Program (FUSRAP) remedial action guidelines and were recommended for formal characterization surveys. (Since the time of this survey, remedial actions have been conducted on the 38 anomalies identified as exceeding FUSRAP guidelines, and the radioactive material above guidelines has been removed.) The remaining 62 anomalies are associated with asphalt driveways and parking lots, which used a phosphate slag material (previously identified as cyclowollastonite, synthetic $CaSiO_3$). This rocky-slag waste material was used for bedding under asphalt surfaces and in general gravel applications. Most of the contaminated soil and rock samples collected at the latter anomalies had approximately equal concentrations of ^{226}Ra and ^{238}U and, therefore, are not related to materials connected with the Niagara Falls Storage Site (NFSS), including material that was transported to the NFSS. 13 refs., 7 figs., 14 tabs.

8590 Gamma-ray exposure from contaminated soil. Jacob, P.; Paretzke, H.G. (Institut fur Strahlenschutz, Gesellschaft fur Strahlen- und Umweltforschung, D-8042 Neuherberg). *Nuclear Science and Engineering;* 93: No. 3, 248-261(Jul 1986).

Exposure at 1 m above the ground from isotropic gamma-ray point sources in the soil has been studied by the Monte Carlo method for source energies from 40 keV to 5MeV. Source depths from 0.1 down to 30 cm and horizontal distances out to 5 mfp have been considered. Considerable deviations were found in the results of different buildup factor methods since such methods do not account for geometric effects at the interface. Moreover, exposures from infinite and finite plane sources have been calculated. It is shown that, for source energies <662 keV, the buildup factor methods underestimate the kerma considerably. It is shown how surface roughness conditions can be accounted for by the introduction of an effective source depth in the soil. The validity of approximations used to describe the exposure from finite or inhomogeneous plane sources with values for infinite homogeneous plane sources was examined.

5105 Site Resource And Use Studies

8591 (PNL—6048) Review of multiphase flow and pollutant transport models for the Hanford site. Kincaid, C.T.; Mitchell. P.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87002728.

This report provides a review of the physical processes, geochemical reactions, and microbiological kinetics that interact to determine the migration and fate of these pollutants. This review of processes and reactions provides a background from which codes for the analysis of contaminant migration and fate can be evaluated. Single codes representing classes of pollutant migration problems are cited to show how commonly employed and publicly available codes are not always applicable to the complex problems of multiphase fluid flow and pollutant migration. This review provides guidance on selecting and using codes; it also provides recommendations for development work needed to address deficiencies identified in existing models, codes, and data bases.

8592 (UCID—20774) Assessment of the extent of trichloroethylene in soil and water at Lawrence Livermore National Laboratory, Site 300. Report of progress in investigations. Carpenter, D.W.; Elwood, R.; Gross, L.G. (Lawrence Livermore National Lab., CA (USA)). 31 Jul 1986. Contract W-7405-ENG-48. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001813.

In 1982 and 1983, LLNL personnel assessed the distribution of trichloroethylene (TCE) in soils, rock, and ground water at five locations within LLNL, Site 300. TCE was found in soil and shallow, perched ground water beneath the 834 Complex and in soil in the vicinity of Spring 3, where TCE has been detected at varying levels during recent years. Soil and rock containing TCE were found at the 854 Complex and at Building 830. TCE was detected in ground water in the vicinity of Well 7 but was not found in soil samples obtained in that area. Following technical review, California Regional Water Quality Control Board (CRWQCB) personnel requested additional geologic and hydrologic information concerning several of the affected areas and, in response to their requests, this supplemental investigation was conducted.

5106 Regulations

REFER ALSO TO CITATION(S) 8241

8593 **(K/HS—109) National Emission Standard for Hazardous Air Pollutants compliance verification plan for the K-1435 Toxic Substances Control Act Incinerator.** Ambrose, M.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 28 Jul 1986. Contract AC05-84OT21400. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002078.

This documentation was prepared for submittal to the Environmental Protection Agency (EPA) in order to meet the requirements of the National Emissions Standards for Hazardous Air Pollutants (NESHAP). This document will emphasize the control of radioactive emissions from the K-1435 Toxic Substances Control Act (TSCA) Incinerator. The TSCA Incinerator is a dual purpose solid/liquid incinerator that is under construction at the Oak Ridge Gaseous Diffusion Plant to destroy radioactively contaminated polychlorinated biphenyls (PCBs) and other hazardous organic wastes in compliance with the TSCA and the Resource Conservation and Recovery Act (RCRA). These wastes are generated at the facilities managed by the Department of Energy, Oak Ridge Operations (DOE-ORO). Destruction of the PCBs and the hazardous organic wastes will be accomplished in a rotary kiln incinerator with an afterburner. The incinerator will thermally destroy the organic constituents of the liquids, solids, and sludges to produce an organically inert ash. In addition to the incinerator, an extensive off-gas treatment facility is being constructed to remove particulate and acidic gas air emissions.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 8591

8594 **(DOE/BP/34796—2) Feeding activity, rate of consumption, daily ration and prey selection of major predators in John Day Reservoir, 1985: Annual report.** Palmer, D.E.; Hansel, H.C.; Beyer, J.M.; Vigg, S.C.; Yasutake, W.T.; Lofy, P.T.; Duke, S.D.; Parsley, M.J.; Mesa, M.G.; Prendergast, L.A. (Fish and Wildlife Service, Cook, WA (USA). Willard Field Station). Oct 1986. Contract AI79-82BP34796. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002972.

This report summarizes activities in 1985 to determine the extent of predation on juvenile salmonids in John Day Reservoir. To estimate consumption of juvenile salmonids we used the composition of the natural diet of predators and in the laboratory determined rate of gastric evacuation by predators. Salmonids were the single most important food item for northern squawfish (Ptychocheilus oregonensis) at McNary tailrace during all sampling periods and at John Day forebay during July. Salmonids accounted for 11.6% of the diet of walleye (Stizostedion vitreum vitreum) in 1985 which was about twice that found in previous years. Salmonids contributed little to smallmouth bass (Micropterus dolomieui) diet but comprised about 25% of the diet of channel catfish (Ictalurus punctatus). Composition of prey taxa in beach seine catches in 1985 was similar to 1983 and 1984 with chinook salmon (Oncorhynchus tschawytscha), northern squawfish, largescale sucker (Catostomus macrocheilus), and sand roller (Percopsis transmontana) dominating the catch at main channel stations and crappies (Pomoxis spp.) and largescale sucker dominating at backwater stations. Preliminary results of beach seine efficiency studies suggest that seine efficiency varied significantly among prey species and between substrate types in 1985. Results of digestion rate experiments indicate that gastric evacuation in northern squawfish can be predicted using water temperature, prey weight, predator weight and time. 19 refs., 19 figs., 13 tabs.

8595 **(DOE/EV/60301—1) Thermal-nutritional regulation of functional groups in running water ecosystems: Informal technical progress report, Year 2, Jan. 1, 1986-Sept. 30, 1986.** Cummins, K.W.; Wilzbach, M.A. (Maryland Univ., Frostburg (USA). Appalachian Environmental Lab.). 1 Oct 1986. Contract FG05-85ER60301. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002443.

Progress for the period January 1, 1986 through September 10, 1986 is summarized. The major emphasis continued to be on the interaction between food quality and growth of representatives of the shredder, collector and scraper functional groups. However, extensive effort also was directed toward aspects of invertebrate mortality in a range of pilot studies during the project period. Three procedures were developed for separating populations of stream macroinvertebrates into groups of individuals which exhibit differential mortality. Initial analyses of stream invertebrate tissue have revealed the presence of pathogens. About 3% of the 425 larvae examined had heavy pathogen loads. This level of infection is approximately that predicted to produce the low mortality observed in natural populations dominated by later instar individuals.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 7896, 7938, 8586, 8588, 8652

8596 **(KFK-PEF—4-Vol.1, pp 435-452) Acidification and heavy metal input in lakes of the Black Forest.** Zoettl, H.W.; Feger, K.-H.; Brahmer, G. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

From May 1984 to June 1985 four Black Forest lakes were examined on chemical input-output and sediment chemistry. The input by precipitation in the studied areas is low in comparison to other areas in Central Europe and differs only slightly. The mass balances for Lake Feldsee and Lake Herrenwies show that the direct atmospheric input onto the lake surface is only important for the heavy metals. The input from the catchments determines the chemical budgets of the lakes, to a high degree. This input, on the other hand, largely depends on the pedological-geological, hydrological, and biological conditions and processes within each catchment.

8597 (KFK-PEF—4-Vol.1, pp 453-464) **Short- and long-term effects of atmogenic pollutant deposition on soil-water and groundwater in Brownstone-Black Forest.** Einsele, G.; Ehmann, M.; Irouschek, T. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Since late autumn 1984, numerous springs and several small river catchment areas have been investigated either by random or continuous measurements in order to determine water chemistry and acid precipitation. The investigated areas are located in the Bunter Sandstone area (of the Black Forest) between Baden-Baden, Pforzheim, and Freudenstadt. Nitrate and sulfate concentrations as well as pH values indicate a distinct regional pattern. This coincides with the varying acid precipitation in different forest areas.

8598 **(PB—87-102356/XAB) Discovery and elimination of dioxins from a carbon reactivation process.** DeMarco, J.; Miller, R. (Cincinnati Water Works, OH (USA)). 1985. 27p. NTIS, PC A03/MF A01.

In a project done to ensure an environmentally acceptable granular activated carbon (GAC) adsorption and reactivation system - to be sure that chlorinated dibenzo-p-dioxins (CDD's) and chlorinated dibenzo furans (CDF's) and combustion would not present problems - results from a GAC system receiving chlorinated water were compared with those receiving unchlorinated water. The studies described here are for exhausting GAC in a post-filtration carbon contactor and reactivating GAC in a fluid-bed reactiva-

tion system. Lower stack emissions of CDD's and CDF's are produced by reactivating GAC that had received unchlorinated water.

8599 **(Y/DZ—231) In-situ biodenitrification of the S-3 ponds.** Napier, J.M.; Bustamante, R.B. (Oak Ridge Y-12 Plant, TN (USA); Tennessee Technological Univ., Cookeville (USA)). 5 Aug 1986. Contract AC05-84OS21400. 34p. (CONF-860826—7). NTIS, PC A03/MF A01; GPO Dep. File Number DE87001637.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

The Y-12 Plant has consistently used calcium acetate in connection with its biodenitrification processes. In 1979, a development program was initiated at the Y-12 Plant for a Department of Energy facility at Weldon Springs, Missouri, to purify liquid wastes stored in open ponds at that site. Bench scale tests indicated that in situ denitrification could reduce nitrates from waste solutions stored at that facility to less that 50 mg/L.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 7984, 8385

8600 **(PB—86-241866/XAB) Drinking-water-criteria document for radium (draft). Scientific review.** (Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water). Apr 1985. 168p. NTIS, PC A08/MF A01.

This document reviews the following topics on radium; Physical and chemical properties; Toxicokinetics and human exposure; Health effects; Mechanisms of toxicity; and Quantification of toxicological effects.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 8592

5206 Regulations

REFER ALSO TO CITATION(S) 8241, 8581

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 8241, 8624

8601 (KFK-PEF—4-Vol.3, pp 881-893) **Cost-effectiveness-analysis of strategies to reduce SO_2- and NOsub(X)-emissions in urban areas.** Baessler, R.; Boysen, B.; Friedrich, R.; Mattis, M.; Voss, A. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

At first, various measures to reduce emissions are selected; the attributes of these measures are determined. In addition, the actual SO_2- and NOsub(x)-emissions in Stuttgart are calculated for the different municipal districts. Then, a scenario of the future development of the emissions is prepared, thereby the already planned measures for environmental protection are considered. In the next step, the application of various additional measures is simulated. Costs and reduction of emissions are determined for every measure. From the results, recommendations for an efficient eco-policy are deduced.

8602 **(NUREG/CR—4492) Methodology for estimating extreme winds for probabilistic risk assessments.** Ramsdell, J.V.; Elliott, D.L.; Holladay, C.G.; Hubbe, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 87p. (PNL—5737). NTIS, PC A05/MF A01 - GPO. File Number TI87002071.

The US Nuclear Reguulatory Commission (NRC) assesses the risks associated with nuclear faciliies using techniques that fall under a generic name of Probabilistic Risk Assessment. In these assessments, potential accident sequences are traced from initiating event to final outcome. At each step of the sequence, a probability of occurrence is assigned to each available alternative. Ultimately, the probability of occurrence of each possible outcome is determined from the probabilities assigned to the initiating events and the alternative paths. Extreme winds are considered in these sequences. As a result, it is necessary to estimate extreme wind probabilities as low as $10^{-7}yr^{-1}$. When the NRC staff is called on to provide extreme wind estimates, the staff is likely to be subjected to external time and funding constraints. These constraints dictate that the estimates be based on readily available wind data. In general, readily available data will be limited to the data provided by the facility applicant or licensee and the data archived at the National Climatic Data Center in Asheville, North Carolina. This report describes readily available data that can be used in estimating extreme wind probabilities, procedures of screening the data to eliminate erroneous values and for adjusting data to compensate for differences in data collection methods, and statistical methods for making extreme wind estimates. Supporting technical details are presented in several appendices. Estimation of extreme wind probabilities at a given location involves many subjective decisions. The procedures described do not eliminate all of the subjectivity, but they do increase the reproducibility of the analysis. They provide consistent methods for determining probabilities given a set of subjective decisions. By following these procedures, subjective decisions can be identified and documented.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 7994, 8040, 8609

8603 **(DOE/ER/70293—T1) Hydrogenases, their cloning, preparation, characterization and modification for use in photobioreactors. Final report.** (California Univ., San Diego, La Jolla (USA)). 1984. Contract AT03-76ER70293. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001753.

The screen for hydrogen evolving activity involved some 40 organisms and strains including photosynthetic bacteria, sulfate reducers, several thermophilic blue green algae, as well as soil bacteria such as Alcaligenes eutrophus and various clostridia. Desulfovibrio vulgaris was found to produce abundant readily extracted hydrogenease of very high specific activity. Attempts at molecular cloning of this hydrogenase gene are described.

8604 **(DOE/EV/02725—T5) Repair of DNA treated with λ-irradiation and chemical carcinogens: Progress report (1983-1986).** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). 1986. Contract AC02-76EV02725. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002721.

This progress report summarizes work on DNA repair of chromatin and then details our progress in developing three model systems. These model systems center on signal transduction in cancer and in carcinogenesis. Molecular biological approaches to three model systems are being developed. The first involves signal transduction controlling sis gene (platelet derived growth factor-β) mRNA levels in human glioblastoma cells. The second involves signal transduction in the activation of a long terminal repeat. The third involves an experiment designed to detect a transposition event in a human cell.

8605 **Aldose reductase in the yeast Pachysolen tannophilus: Purification, characterization, and N-terminal sequence.** Bolen, P.L.; Bietz, J.A.; Detroy, R.W. (US Department of Agriculture, Peoria, IL 61604; Signal UOP Research Center, Des Plaines, IL). pp 129-148 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

Recent studies have implicated a requirement for NADH-dependent xylose reductase activity in yeasts that anaerobically ferment D-xylose to ethanol. The xylose-fermenting yeast Pachysolen tannophilus was reported to have minor NADH-dependent xylose reductase activity in crude cell extracts, but purified xylose reductase from this organism was found to be highly specific for NADPH. We report herein the purification of an aldose reductase from P. tannophilus that catalyzes conversion of xylose, arabinose, or galactose to their corresponding alcohols when either NADPH or NADH is supplied as cofactor. The highly purified enzyme consists of a single-subunit nonglycosylated protein (36,000 daltons) and yields an unambiguous amino-terminal sequence. 33 refs., 9 figs., 3 tabs.

8606 **Analysis of the effect of chemical modification on the activity and stability of enzymes.** Sadana, A.; Henley, J.P. (Univ., of Mississippi, University, MS 38677). pp 479-490 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The effect of modification of enzymes on their activity is often the general opposing nature or inverse relationship exhibited by enzyme stability and activity. This is seen by the external chemical modification of lactate dehydrogenase by methyl acetimidate, exopenicillinase by lutaraldehyde, and by the mild succinylation of E. coli asparaginase. For the first two examples, the intramolecular crosslinks provided by the reticulating agents make the enzyme structure more rigid which enhances stability but decreases specific activity. On other occassions the specific activity is decreased while stability or residual activity is not significantly affected. This is seen for the succinylation or acetylation of E. coli asparaginase. A third possible category could be the case when the enzyme molecule is modified at positions distant from the active site. This may drastically affect the enzyme stability, while leaving its specific activity unaltered. It is suggested that the basic protection or stabilization lies in the initial enzyme state. This is due to the fact that when the specific activity of an enzyme is increased on chemical modification, its deactivation velocity constant decreases. 26 refs., 3 figs., 3 tabs.

5503 Cytology

REFER ALSO TO CITATION(S) 8610

5504 Genetics

REFER ALSO TO CITATION(S) 8604

8607 **(CONF-8610146—5) Genetic algorithms as discovery programs.** Hilliard, M.R.; Liepins, G. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE87002410.

From Southeastern TIMS meeting; Myrtle Beach, SC, USA (9 Oct 1986).

Genetic algorithms are mathematical counterparts to natural selection and gene recombination. As such, they have provided one of the few significant breakthroughs in machine learning. Used with appropriate reward functions and apportionment of credit, they have been successfully applied to gas pipeline operation, x-ray registration and mathematical optimization problems. This paper discusses the basics of genetic algorithms, describes a few successes, and reports on current progress at Oak Ridge National Laboratory in applications to set covering and simulated robots.

5505 Metabolism

REFER ALSO TO CITATION(S) 8039, 8640

5506 Medicine

REFER ALSO TO CITATION(S) 8236, 8242, 8622, 8622

8608 **Alkaloid recovery for plant cell systems.** Payne, G.E.; Shuler, M.L. (Cornell Univ., Ithaca, NY 14853). pp 633-639 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

The production of indole alkaloids by periwinkle (Catharanthus roseus) has been observed from cells immobilized in dialysis tubing. These results suggest that alkaloids can be produced by periwinkle in a semicontinuous or continuous immobilized cell system. However, the low product concentrations and the presence of a mixture of several similar alkaloids limits the economic viability. The observed variability of plant cells limits the selection and maintenance of variants with favorable production characteristics. Improvements in the primary recovery steps can effectively satisfy the goals of increasing product concentrations and reducing the complicating effects of the presence of several chemically related products. The possibility that the production of these alkaloids may be controlled by feedback regulation also makes this system an attractive potential candidate for on-line product removal. Ajmalicine is presently obtained from the extraction of whole plants, and used in the treatment of circulatory disorders. In plant cell cultures of periwinkle, ajmalicine is produced in low concentrations (typically less than 15 mg/L), and in the presence of several structurally related indole alkaloids. 9 refs., 4 figs., 2 tabs.

5507 Microbiology

REFER ALSO TO CITATION(S) 8045, 8058

8609 **Construction of plasmids for the transformation of Methanobacterium thermoautotrophicum.** Feldman, D.; Yang, S.-T.; Ho, N.W.Y. (Purdue Univ., West Lafayette, IN 47907). pp 235-240 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott, C.D. (ed.). New York; John Wiley and Sons, Inc. (1986). (CONF-850513—).

From Symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1985).

The establishment of a plasmid-mediated transformation system for Methanobacterium thermoautotrophicum will allow the study of its molecular mechanisms and the improvement of its capability by recombinant DNA techniques. Construction of a plasmid vector containing a functional replication origin and a selectable genetic marker is the prerequisite for the establishement of a transformation system for any organism. This article relates the construction of two such plasmid vectors, pLM1 and pLM3, for M. thermoautotrophicum. 19 refs., 5 figs., 2 tabs.

8610 **Mathematical modeling of receptor-mediated mammalian cell phenomena.** Lauffenburger, D.A.; Linderman, J.J.; Hammer, D.A. (Univ. of Pennsylvania, Philadelphia, PA 19104). pp 675-688 of Biotechnology and bioengineering symposium No. 15: Proceedings of the seventh symposium on biotechnology for fuels and chemicals. Scott. C.D. (ed.). New York, NY; John Wiley and Sons, Inc. (1986). (CONF-850813—).

From 11. international conference on atomic collisions in solids; Washington, DC, USA (4 Aug 1985).

A variety of receptor-medicated mammalian cell behavior is involved in biotechnological processes, such as growth factor regulation of cell growth and specific cell adhesion to surfaces for immobilized cell reactors or cell separations. Also, many biochemical products are molecular ligands that regulate physiologically important receptor-medicated cell behavior, e.g., immune cell responses. Thus, mathematical modeling of receptor-mediated cell phenomena will be of importance in both production and use of biotechnological products. This article describes modeling approaches we are currently using to analyze two example problems of receptor-mediated cell phenomena: receptor-ligand processing dynamics and specific cell adhesion. 37 refs., 8 figs.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 8022, 8236, 8301

8611 **Stable-carbon isotope variability in tree foliage and wood.** Leavitt, S.W.; Long, A. (Univ. of Wisconsin-Parkside, Kenosha). *Ecology;* 67: No. 4, 1002-1010(Aug 1986). Contract AC05-84OR21400.

This study documents variation of stable-carbon isotope ratios ($^{13}C/^{12}C$) in trees of genera Juniperus and Pinus under field conditions. Results are from cellulose analysis on leaves, twigs, and wood from a number of localities in the southwestern US. Substantial variability, typically 1-3%, exists among leaves, within wood (radially, vertically, circumferentially), and between individuals at a site. These results may help guide sampling in tracer-type studies with stable-carbon isotope ratios and aid in the interpretation of isotopic results from such studies.

8612 **The philosophy of quarantine treatment as related to low-dose radiation.** Ouye, M.T.; Gilmore, J.E. (National Program on Product Losses, ARS, USDA, Beltsville, MD 20705). pp 67-69 of Radiation disinfestation of food and agricultural products. Moy, J.H. Honolulu, HI; University of Hawaii at Manoa (1985). (CONF-8311102—).

From International conference on radiation disinfestation of food and agricultural products; Honolulu, HI, USA (14 Nov 1983).

The purpose for quarantine treatment is to prevent establishment of exotic pest populations from quarantined areas to nonquarantined areas through movement of host commodities. Quarantine treatment schedules approved by the Animal Plant Health Inspection Service (APHIS), U.S. Dept. of Agriculture (USDA), appear in its "Plant Protection and Quarantine Programs Treatment Manual." These treatment schedules were developed through research demonstrating that when followed to the letter, quarantine security or negligible pest risk would be achieved. Negligible pest risk is currently synonymous with probit 9, the level of security at which no more than 3.2 pests per 100,000 treated will survive. Probits are based on mortality; therefore, relatively high dosages will be required and in some instances could damage the commodity at the dosage necessary to kill the pest. If the purpose of quarantine treatment is to prevent perpetuation of the pest species into nonquarantined areas, the criterion should be based on the ability of the treated pests to reproduce. The criteria currently being discussed by APHIS and the Agricultural Research Service are presented. Two key criteria are a redefinition of negligible pest risk and the concept of a two-stage quarantine treatment schedule.

8613 **Insect disinfestation of pulses by irradiation.** Bhuiya, A.D.; Ahmed, M.; Rezaur, R.; Seal, D.R.; Nahar, G.; Islam, M.M.; Islam, M.S. (Institute of Food and Radiation Biology, Atomic Energy Research Establishment, P.O. Box No. 3787, Dhaka). pp 214-221 of Radiation disinfestation of food and agricultural products. Moy, J.H. Honolulu, HI; University of Hawaii at Manoa (1985). (CONF-8311102—).

From International conference on radiation disinfestation of food and agricultural products; Honolulu, HI, USA (14 Nov 1983).

Studies were carried out on four varieties of pulses, namely, mosur or lentil (Lens esculenta), mung (Phaseolus aureus), chola or gram (Cirecer aricitinum), and mashkalai (Phaseolus radiatus). Two major burchid betles, Callosobruchus chinensis (L.) and Callosobruchus analis (Fab.), were found to infest different varieties of pulses. Radiation sensitivity of the two pulse beetles was determined at different developmental stages (i.e., eggs, larvae, and pupae). Emergence of adults from eggs totally stopped at a dose of 0.04 kGy. Doses of 0.28 and 0.32 kGy, respectively, were required for complete inhibition of adult emergence from irradiated fourth instar larvae of C. analis and C. chinensis. Studies revealed that the experimental gram was heavily infested (65-91 percent) as compared to other pulses after 8 months of storage in all packaging materials used (gunny bag, gunny bag lined with polyethylene, polyethylene and polyvinyl chloride bags). Mashkalai showed insignificant damage (2-5 percent) by the insects. Reinfestation in the treated products was observed in polyethylene and gunny bags.

8614 **Statistical basis for quarantine treatment schedule and security.** Chew, V.; Ouye, M.T. (Biometrics Unit, ARS, USDA, 412 Rolfs Hall, Univ. of Florida, Gainesville, FL 32611). pp 70-74 of Radiation disinfestation of food and agricultural products. Moy, J.H. Honolulu, HI; University of Hawaii at Manoa (1985). (CONF-8311102—).

From International conference on radiation disinfestation of food and agricultural products; Honolulu, HI, USA (14 Nov 1983).

This paper discusses the design of experiments for the development of a quarantine treatment schedule, including the number and selection of design points and the number of experimental units at each design point. The fitted response surface equation can be used to predict the treatment schedule that will provide any desired security level. This estimated schedule may be validated in a confirmatory test. The paper also proposes replacements of the customary probit 9 security level with the risk probability of introducing a pest into a noninfested geographical area.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 8553, 8604, 8604

8615 (DOE/EV/00119—261, pp 29-30) **Localization, distribution and dosimetry of actinides in the gonads.** Miller, S.C. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

This research was initiated to study the localization and distribution of actinides in gonads, to determine the biological and immunological determinants of nuclide deposition and retention, and to extrapolate the possible risk from nuclide exposure to humans. Some of the biological processes that appear to be involved with nuclide incorporation and retention include activity of the mononuclear phagocyte system, vascular permeability and transport, lymphatic flow, iron metabolism, and the transferrin system. In addition, age and the state of gonadal maturation appear to be important determinants of nuclide incorporation and retention in the gonads. The distribution of the radionuclides and potential radiation exposures to germ and somatic cells in humans was to be predicted based on the comparative structure and morphometry of gonadal components in different species. Because of differences in the histological composition of gonads among mammals, beagles and several different species of rodents (rats and guinea pigs) were used. Light and electron microscope autoradiographic localization of ^{241}Pu was used to simulate the alpha-track distribution of ^{239}Pu. During the tenure of this program the authors developed and applied techniques to systematically analyze the subcellular localization of ^{241}Pu using electron microscopy and quantitative morphometry. The localization of ^{239}Pu and other actinides was determined by conventional autoradiography and neutron-induced autoradiography (NIAR). In addition, NIAR was used to attempt to localize Pu in human autopsy and biopsy tissues.

8616 (DOE/EV/00119—261, pp 33-36) **Comparative metabolism of actinides.** Wrenn, M.E.; Singh, N.P. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

An attempt is made to understand the biokinetics of actinides in different species and improve mathematical models which will better allow the extrapolation between animals and man and between different radioelements. It has a second objective to determine the natural background radiation doses from internally deposited alpha-emitters in the colony and at other DOE supported colonies. During the last year the authors completed a review of the metabolism of uranium in man and animals. They concluded that the gastrointestinal absorption of uranium by man was about 1.4%, based on human data. However, numerous experimental results in the rat showed an absorption an order of magnitude lower, about 0.1%. The review of the literature convinced them that mathematical models of metabolism in man for uranium need to be improved, and in particular the authors know very poorly the average GI absorption by man from food and water. In addition, currently accepted parameters for a long term compartment in human bone are questionable. The authors have measured the alpha emitting isotopes of uranium, thorium and plutonium by radiochemical techniques in tissues from two dogs each of three age groups, juveniles (3 months), young adults (18 months), and old dogs (9 years). The comparative distribution among organs suggests that the distribution of these nuclides among the organs is similar in all three age groups. In addition, the information suggests that there are reasonable similarities between the distribution in man and older dogs.

8617 (DOE/EV/00119—261, pp 87-90) **Some problems in the skeletal dosimetry of bone seeking radionuclides.** Lloyd, R.D. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

In a given species, each bone seeking radioelement has its own pattern of skeletal uptake, distribution, and retention. Age, sex, and other biological factors can also affect these characteristic patterns. Therefore, to derive an appropriate dosage parameter for any mammal, it is necessary to determine not only the amount of radioactivity to which the individual is exposed or the amount that is incorporated into the body, but also the fraction that is deposited in the skeleton, its distribution pattern, and the change in skeletal retention as a function of time after exposure. Several complicating features make it essential to choose some common parameters that will allow the overall effects of different radionuclides to be compared directly. Some of these parameters include: (a) the variety of radiations emitted by the different bone seeking radionuclides, (b) the disparity in the energy imparted to the skeleton by these emitters, and (c) the absence or presence of a series of radioactive daughter products in their decay chains (each with its own physical, chemical, and biological properties). Radiation energy absorbed in an organ or tissue of interest has provided a useful scheme for comparison, usually expressed in terms of units of energy deposited per unit mass of tissue (ergs per gram, joules per kilogram, etc.). Cumulative radiation dose is simply the total energy absorbed in the organ or tissue divided by its mass. Special units of radiation dose are the rad (= 100 ergs/gram) and the gray (= 1 joule/kg = 100 rad = 10^{-3} joule/gram).

8618 (DOE/EV/00119—261, pp 95-100) **Baseline hemogram of peromyscus maniculatus.** Teckman, J.H.; Rojas, J.; Carlisle, P.; Taylor, G.N.; Wrenn, M.e. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

The Deer mouse, Peromyscus maniculatus, is being used more extensively as an animal model in biological research. At the Radiobiology Division of the University of Utah, preliminary studies have shown that the radionuclide retention characteristics of Peromyscus, especially involving bone and liver retention, are similar to a well defined beagle model and humans. Also, a colony of Peromyscus under study can be maintained more easily, at less cost, in much less space, and in greater numbers as compared to larger mammals. In addition, mouse studies can be conducted for the same proportion of the animals' life span in much less real time. For these reasons, a concerted effort is underway to define the normal biology of Peromyscus so that the model can be used in radionuclide studies designed to estimate human risk. One phase of this study was to characterize the normal Peromyscus hemogram because of dose-response relationships that exist between the cells of the peripheral blood and bone marrow irradiation. Results have already indicated that this animal model will be of value in estimating the toxicity of Pu-239 and possibly that of other actinide elements in humans.

8619 (DOE/EV/00119—261, pp 101-108) **Bioassay of plutonium and uranium by fission track analysis.** Paschoa, A.S.; Bruenger, F.W.; Smith, J.M.; Singh, N.P.; Lewis, L.L.; Wrenn, M.E. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

An ultrasensitive method to measure ^{235}U and ^{239}Pu in human tissues, based on fission track analysis, is briefly described. Plutonium-239 concentrations in 25 aliquots of about 1 g taken from six whole livers collected at autopsies of human subjects from southern and northern Utah, without any known occupational exposure to plutonium, were compared with the ^{239}Pu concentrations determined by alpha and mass spectrometry. About 1 fCi of ^{239}Pu can be measured in a single sample. The results obtained by fission track analysis indicated that ^{239}Pu was very uniformly distributed in these human livers. The potential application of fission track analysis to needle biopsies to measure ^{239}Pu burdens of about 5 pCi or more in human liver is discussed.

8620 (DOE/EV/00119—261, pp 109-112) **Comparative distribution of iron and plutonium in the ovary.** Dougan, S.T.; Bowman, B.M.; Miller, S.C. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

Experiments were performed to determine the relationship between iron and Pu deposits in the ovary by injection plutonium 241 - citrate into rats. Results indicate that most of the iron deposits were found in large, vacuolated cells in the interstitial areas. One week after Pu administration, most of the Pu was observed in atretic follicles. In most cases, iron could also be found in these areas in the corresponding adjacent section. The cellular areas where concentrations of Pu were found generally contained relatively small aggregates of iron. After six weeks, Pu was found in vacuolated cells in the interstitial tissue. These cells resembled those in which the larger deposits of iron were found. The correlation of iron and Pu deposits provides further support for the suggestion that Pu and iron have the same mechanism for incorporation into the ovary. This study also indicates that Pu and iron may have the same binding sites within the ovary.

8621 (DOE/EV/00119—261, pp 113-118) **Localization of plutonium-241 in the rat ovary.** Dougan, S.T.; Bowman, B.M.; Miller, S.C. 31 Dec 1985. NTIS, PC A09/MF A01. File Number DE86015873. (COO—119-261).

In Research in radiobiology. Annual report, Internal Irradiation Program.

Light and electron microscope autoradiography was used to identify Pu-containing cells and to propose possible biological mechanisms for the change in Pu distribution in the ovaries. Rats were injected with plutonium 241 and examined for the distribution of Pu. Autoradiographic grains were noted at a level slightly above background throughout most of the ovary. There were more grains over atretic rather than developing follicles. Deposits were also seen over spaces morphologically similar to lymphatic vessels and in interstitial macrophages.

8622 (NUREG/CR—3955) Age- and sex-specific estimation of dose to a normal thyroid from clinical administration of iodine-131. Killough, G.G.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA). Health and Safety Research Div.). Sep 1986. Contract AC05-84OR21400. 35p. (ORNL/TM—9800). NTIS, PC A03/MF A01 - GPO. File Number TI86015368.

This report describes the derivation of an age- and sex-dependent model of radioiodine dosimetry in the thyroid and the application of the model to estimating the thyroid dose for each of 4215 patients who were exposed to ^{131}I in diagnostic and therapeutic procedures. In most cases, the data available consisted of the patient's age at the time of administration, the patient's sex, the quantity of activity administered, the clinically determined uptake of radioiodine by the thyroid, and the time after administration at which the uptake was determined. The model was made to conform to these data requirements by the use of age-specific estimates of the biological half-time of iodine in the thyroid and an age- and sex-dependent representation of the mass of the thyroid. Also, it was assumed that the thyroid burden was maximum at 24 hours after administration (the ^{131}I dose is not critically sensitive to this assumption). The metabolic model is of the form A(t) = K x (exp(-μ_1t) - exp(-μ_2t)) μCi where μ/sub i/ = λ/sub r/ + λ/sub i//sup b/ (i = 1, 2), λ/sub r/ is the radiological decay-rate coefficient, and the λ/sub i//sup b/ are biological removal-rate coefficients. The values of λ/sub i//sup b/ are determined by solving a nonlinear equation that depends on assumptions about the time of maximum uptake and the eventual biological loss rate (through which age dependence enters). An addendum (Appendix C) extends the method to other radioiodines and gives age- and sex-dependent dose conversion factors for most isotopes.

8623 (UCRL—50400-Vol.29) Calculated photon KERMA factors based on the LLNL EGDL [Evaluated Gamma-Ray Data Library] data file. Howerton, R.J. (Lawrence Livermore National Lab., CA (USA)). 10 Oct 1986. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003088.

Photon (Gamma-Ray) KERMA factors calculated from the LLNL EGDL (Evaluated Gamma-Ray Data Library) file are tabulated for the elements from Z=1 to Z=30 and for 15 composite materials. The KERMA factors are presented for 191 energy groups over the incident photon energy range from 100 eV to 100 MeV. 3 refs.

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REFER ALSO TO CITATION(S) 7918, 8580, 8582, 8585

8624 (DOE/LC/10924—2168) Evaluation of occupational health and environmental hazards associated with storage and processing of fossil fuels. Final report. Culver, B. (Wyoming Univ., Laramie (USA). School of Pharmacy). Aug 1986. Contract AS20-82LC10924. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86006574.

Experimental groups of rats were maintained at the LETC North Site retort building for periods of 5 to 8 days during four separate burns of the ten-ton retort. The oil shale used in all four retort tests was from the DOE Anvil Points Mine near Rifle, Colorado and contained 23 +- 2 gallons of oil per ton. Two control groups of animals were housed in the animal care facilities. One group was subjected to similar physical conditions (temperature, sound, lighting) as those experienced by experimental animals in the retort building while the other control group was maintained under standard animal care facility conditions. Blood and tissue samples were taken from most animals the same day the exposures were terminated although some animals were sampled at periods of 1 to 3 weeks after exposure, to see if the effects were reversible. A detailed toxicological screening procedure which included numerous biochemical, physiological and histopathological measurements was used to evaluate the effects of the exposures. Experimental groups of rats maintained in the retort building showed changes in liver function, serum enzymes and catecholamines, some histological alterations, and, for rats exposed during pregnancy, possible adverse fetal effects. The magnitude of these changes varied with the different retort tests. However, control rats maintained under simulated physical environments also showed a few biochemical and developmental effects that were similar to those of experimental animals indicating the contribution of physical factors to some of the changes. Together, the results indicate that the experimental design and toxicological screening procedures used in these studies provide a relatively inexpensive and simple approach for prediction of potential health risks to animals, including man.

8625 (DOE/PETC/TR—87/3) Growth of Phanerochaete chrysosporium: A white-rot fungus, on peat hydrolysate. Dahlberg, M.D.; Noceti, R.P. (USDOE Pittsburgh Energy Technology Center, PA). Oct 1986. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002512.

Fungi may be useful for low-cost, low-energy-requiring processing of fossil fuels. We investigated the suitability of peat hydrolysate as a growth medium for a fungus that may be able to produce chemicals from fossil fuels, either as secondary metabolities or lignin-degradation products. The biomass yield was greater in phosphate-amended cultures than yields reported for other species grown on peat hydrolysate. Supplemental carbohydrate with phosphate increased the biomass but reduced the efficiency of carbohydrate utilization. There was no evidence of growth inhibitors in the hydrolysate, and a reduction in fulvic acid concentration did not enhance growth. It was postulated that based on this and studies in the literature, the suitability of peat hydrolysate as a growth substrate may be dependent on the source of peat and method of hydrolysis, as well as the organism.

8626 (KFK-PEF—4-Vol.1) Project European Research Center for Air Pollution Abatement Measures. Vol. 1. Horsch, F.; Filby, G.; Fund, N.; Gross, S.; Hanisch, B.; Kilz, E.; Seidel, A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1986. 467p. (In German). (CONF-8603154—Vol.1). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294.

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

During the 4-7th of March 1986 the Second Status Report of the Project 'European Research Center for Air Pollution Control Measures' took place in the Nuclear Research Center, Karlsruhe. Progress reports on the assessment and analysis of the impact of airborne pollutants on forest trees, distinction from other potential causes of recent forest dieback are contained in the present Volume 1.

8627 (KFK-PEF—4-Vol.1, pp 1-9) Development of an inventory technique for damaged forest trees by means of computer aided multi-spectral remote sensing data. Hildebrandt, G.; Kadro, A.; Kuntz, S. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungazentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

This paper presents an investigation of spectral reflection properties of forest vegetation, esp. in reference to the difference between healthy and damaged trees and stands. The investigation is based on the evaluation of multispectral scanner data in the spectral regions visual, near IR and middle IR of the electromagnetic spectrum. Data was collected from different flight altitudes. A computer-aided classification for forest stand damage inventory is presented and discussed.

8628 (KFK-PEF—4-Vol.1, pp 11-26) Twostage inventory of forest damages. Hildebrandt, G.; Grundmann, O.; Schmidtke, H.; Tepasse, P. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

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The first stage included a large number of aerial photo plots with few variables linked with a second stage of a few terrestrial permanent plots (PP) but with a higher number of variables. This has been done by siting PP's on topographic scale 1:25000 maps 4 km apart each other on the flightlines. The PP's were located and targeted on the ground so that they clearly could be identified on subsequently flown CIR, 1:5000 scale aerial photographs. Simultaneous with the flight mission, damage data on the PP's were collected on the targeted center and surrounding 19 trees. Additional parameters of stand, soil and growth were also acquired. Terrestrial and aerial data files of the damage situation are now available for all PP's and will be analysed by regression methods.

8629 (KFK-PEF—4-Vol.1, pp 27-42) **Monitoring of air pollution effects on biological indicators in areas of forest disease in Baden-Wuerttemberg (active monitoring of vegetable bioindicators).** Pilgram, C.; Arndt, U.; Schlueter, C. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Plants of the ozone sensitive Nicotiana tabacum cultivar Bel-W 3 and Phaseolus vulgaris var. Pinto were exposed together with the Trifolium pratense var. Hege as an indicator for O_3 and SO_2 and the Vicia faba var. Herra for SO_2 at 15 sites in four areas of forest disease in Southwest-Germany. Also Lolium perenne was used as an accumulation indicator for Zn, Pb, Cd, S and F. The leaf injuries at the plants were recorded weekly, that means twice in each of the eight exposure periods in 1985. At the stations in the south of the Black Forest only one recording in each of the two week periods was possible. Phytotoxic concentrations of ozone occured at all of the stations and in every exposure period. In the southern region of Stuttgart there were only slight injuries at the plants while in the western area of the Black Forest heavy damages occured and often the leaves of the tobacco plants were totally destroyed by ozone. Relations could be shown between the wind direction and the dimension of damages at the plants and between ozone concentration and injuries for some periods.

8630 (KFK-PEF—4-Vol.1, pp 55-64) **Anatomic and histochemical examinations for the clarification of the contribution of biotic agents to forest dieback.** Fink, S. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

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In yellowed needles of firs and spruces from forest decline areas in the Southern Black Forest frequently necrotic phloem could be found, while the mesophyll cells were still intact. This first led to the assumption of a possible participation of phloemspecific pathogens (viruses, MLO). Needles suffering from atmospheric pollutants in contrast showed necroses of mesophyll cells with largely intact phloem. Identical symptoms with collapsed phloem and intact mesophyll could be observed in spruces which showed typical apical yellowing of the needles after cultivation in magnesium-free hydroponic solution. The symptoms on the yellowed needles in the higher Black Forest can therefore conclusively be explained with the there observed magnesium-deficiency. Possible interrelationships between biotic pathogens and nutritional status of the trees are discussed. In a number of yellowed, but also some green needles, fungal hyphae could be observed in the microscopical sections, preferably in the intercellulars. The significance of these fungi will further be investigated.

8631 (KFK-PEF—4-Vol.1, pp 65-77) **Investigations on the hormone-balance of healthy and damaged conifers.** Frenzel, B.; Christmann, A. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Parallel to a visual characterization of the state of health in spruce and fir of the Black Forest and of the Welzheimer Wald to the east of Stuttgart, plantphysiological observations and determinations of the ethylene-precursor ACC and its most important derivative MACC as well, were done: The visual characterization of the healthy tree is not always reliable; Even only faintly ill trees show an increased content of MACC and/or ACC; Changes in both these substances do not always parallel each other; These changes due to the illness of the investigated trees are superimposed on different contents of both these substances thanks to ecological conditions of the biotopes investigated; It is not known, whether young and older trees respectively, experience the same intensity of illness-correlated changes in both the substances investigated. A method for the determination of abscisic acid is described.

8632 (KFK-PEF—4-Vol.1, pp 79-95) **Fluorescence and electron microscopic investigations of the phloem of beeches, spruces and firs showing different degrees of damage symptoms.** Schulz, A.; Behnke, H.-D. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The phloem of beeches, spruces and firs showing different degrees of damage symptoms (standard damage classification 0-3) was investigated with microscopic methods to examine their possible infections with mycoplasma-like-organisms (MLO), rickettsia-like-bacteria (RLB), and viruses. During the growing seasons of the years 1984 and 1985 root-, stem- and branch parts of up to 39 trees growing in three different areas were removed at monthly intervals and subsequently screened. Prerequisite to these investigations is a knowledge of the composition of the secondary phloem in these trees and of cytological changes which occur during the differentiation of the different phloem cells. None of the many samples contained MLO, RLB or viruses, and the rare occurrence of single structures which could be misinterpreted as MLO is discussed. Judged by this negative result of an in-situ-localization in the phloem of damaged trees, MLO, RLB and viruses are excluded as a primary factor of the new forest damage - for which a systemic spread would be prerequisite-, while a predisposing role of viruses was not likely to be shown with the methods applied.

8633 (KFK-PEF—4-Vol.1, pp 97-114) **Measurement of photosynthesis of healthy and damaged trees: Search for parameters of early detection of tree damage.** Lichtenthaler, H.K.; Schmuck, G.; Nagel, E.; Buschmann, C. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

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That damage to the photosynthetic apparatus and the photosynthetic capacity - be it direct or indirect - is one of the main causes of the large scale tree damage, was proved in our extended outdoor and laboratory photosynthetic measurements using different methods. Damaged trees (North and South Black Forest) not only exhibit fewer needle-years, the remaining needles possess significantly lower photosynthetic rates. The comparative determination of photosynthetic parameters is therefore an effective instrument in the future investigations of forest dieback. As suitable methods we recommend the determination of the in vivo chlorophyll fluorescence (Rsub(fd)-values), the ratio of green to yellow leaf pigments (chlorophylls/carotenoids a+b/x+c), the measurement of gas exchange (CO_2/H_2O-porometer) together with the measurement of the water potential (Scholander pressure device) and the new method of photoacoustic spectroscopy (pas-signals).

8634 (KFK-PEF—4-Vol.1, pp 115-128) **Pollutant effects on the conformation of chlorophyll-protein complexes in forest trees suffering from air pollutant stress. Pt. 2. Pigment content and characteristics of the light-harvesting chlorophyll-a/b-protein complex in needles of healthy and damaged spruce trees in the area Kaelbelescheuer (Southern Black Forest).** Siefermann-Harms, D.; Ninnemann, H. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Symptoms of the forest decline type 'photobleaching in higher altitudes' are studied with spruce trees, Picea abies (L.) Karst., growing in a clean-air area. The pigment content in 1- and 2-year old needles of spruce tree 'No. 5' (strongly damaged; 70% of needles, mainly the older ones, lost) is reduced as compared with 2 healthy controls. Chl-a, Chl-b, carotene, violaxanthin and neoxanthin are lowered at similar degree, while lutein shows little change. The same pattern of pigment bleaching is observed in light-exposed 3-year old needles of spruce tree 'No. 22' (strongly damaged; 30% of needles lost) while no bleaching is observed in 3-year old shaded needles of the same tree. The pattern of pigment bleaching observed in the damaged trees differs from that induced by exposing spruce trees to chloroethenes. The light-harvesting Chl-a/b-protein (LHC) isolated from needles of spruce No. 5 or from shaded needles of spruce No. 22 is less stable under acidic conditions than LHCs from healthy controls. This observation points at some conformational change occurring in LHCs of the damaged trees. Since a decreased acid stability is observed for the LHC from shaded needles of tree 22 the pigments of which are not bleached, we consider that some conformational change of the LHC might precede light-induced pigment bleaching.

8635 (KFK-PEF—4-Vol.1, pp 129-148) **Analysis of compositional variation in needles and deciduous leaves of pollution damaged forest trees. Quantitative analysis of terpenes and VOC in needles of Picea abies and forest air.** Juettner, F. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Mono- and sesquiterpenes and their derivatives were determined qualitatively and quantitatively in needles of Picea abies exhibiting different damage symptoms. The damage state that leads to a loss of needles without preceding yellowish chlorosis (Welzheimer Wald) did not significantly change the concentrations of mono- and sesquiterpenes. However, when the symptoms involved yellowish chlorosis as is typical for elevated sites (Kaelbelescheuer, Southern Black Forest) the concentrations of terpenes were markedly affected. The monoterpene concentrations were increased, those of the sesquiterpenes lowered in yellowish needles. Two metabolites, presumably of microbial origin, were detected in needles: 5-methylheptan-3-one and oct-1-en-3-ol. The latter was a product of Chrysomyxa rhododendri. The emission of monoterpenes in the forest air was very low in winter time but high in the autumn. The amounts then observed should be sufficient to effectively participate in aeriel chemical reactions. VOC which are pollution products were observed in high concentrations at the measuring site (Kaelbelescheuer). Calm weather conditions seem to induce not only the formation of high concentrations of ozone but also to enable the build up of high concentrations of organic pollutants.

8636 (KFK-PEF—4-Vol.1, pp 149-163) **Lipid peroxidation: A phytotoxic consequence of air pollutants.** Kunert, K.J.; Mehlhorn, H.; Schmidt, A. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Spruce and fir, both 10 years of age, were exposed to purified air, ozone (0.14 mg/m^3 air), SO_2 (0.03 mg/m^3 air), or a combination of both gases in open top chambers. With age, a combination of both gases significantly increased the content of the antioxidants vitamin E and C and glutathione in needles of fir and spruce when compared to the control treated with purified air. The increase was stronger in needles of fir than in needles of spruce. Further, the increase was already found in the youngest needles of fir. Compared to the control, no significant higher amount of antioxidants was observed when trees were exposed to ozone alone. Moreover, ozone exposure was less effective than SO_2 exposure. Combination of both air pollutants induced synergistic effects. In field studies (location: Schwarzwald, Kaelbelescheuer/Haldenhof), needles of spruce also showed an increase in the vitamin E content dependent on the extent of damage. This increase was partly accompanied by a higher amount of vitamin C and an increased degree of lipid peroxidation, measured as ethane production. Our results from open top experiments are consistent with our previous data investigating natural aging in higher plants. Therefore we suggest that by the phytotoxic action of air pollutants, such as SO_2 and SO_2 + ozone, age-related peroxidative processes are accelerated. Further, both vitamin E and glutathione are specific indicators of these processes. By now, no direct and significant correlation between field studies and studies with open tops has been found.

8637 (KFK-PEF—4-Vol.1, pp 165-185) **Investigations on the role of macro- and micromineral nutrients and of other elements in the decline of forest trees.** Krivan, V.; Schaldach, G.; Hausbeck, R.; Luettge, U.; Kreutzer, K. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

In the final period of this research project, the distribution of the elements between the biomass and the surface deposition was investigated on needles (Picea abies) of five different regions with varying atmospheric deposition. It was found that in the case of the elements Ba, Ca, Co, K, Mg, Mn, N, Rb, S, and Zn, the surface deposition, relative to content in the biomass, has no or little importance. However, for the elements Al, Cd, Cr, Cs, Cu, Fe, Pb, Sc and Th, the fraction deposited on the surface is 20-95% of the total amount - depending on region, element and age class. Consideration of the element distribution between these two components is of principal importance in the interpretation of the element contents in the needles. The comparative investigation on trees of Picea abies (needles, fine roots, soil extracts) in different state of health were continued. According to the results obtained, supply and distribution of mineral nutrients cannot be considered as the primary cause for the diseases. Comparison of the measured contents with the literature values of deficiency threshold concentrations shows that most trees including the healthy ones may suffer insufficient supply of K, Ca, and Zn, and a more or less severe magnesium deficiency. However, basic conifer physiology appears to be insufficiently developed to allow stronger conclusions. The influence of artificial acidic rain and of the vegetation time was also investigated.

8638 (KFK-PEF—4-Vol.1, pp 187-199) **Levels of adenine nucleotides (ATP, ADP, AMP) and of inorganic phosphate in needles of Picea abies, representing different stages of development and of pollution dependence.** Benz, T.; Hampp, R. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Levels of adenine nucleotides (ATP, ADP, AMP) and of inorganic phosphate in needles of Picea abies, representing different stages of development and of pollution dependence. Lyophilized needles of Picea abies (Kaelbelescheuer, southern Black Forest) were analyzed for their content of adenine nucleotides (ATP, ADP, AMP: AdN) and of inorganic phosphate (Psub(i)). The metabolite levels were related to needle age, vegetation period and degree of damage (chlorophyll content). The results were as follows: 1) With increasing needle age there is a general decrease in the total AdN-pool. This decrease is most pronounced in very young needles and occurs in both healthy and damaged tissue. 2) The ATP/ADP-ratio of damaged needle is significantly higher than that of healthy ones. 3) Both phosphorylation potential $(ATP.(ADP.Psub(i))^{-1})$ and adenylate energy charge $((ATP + 0.5.ADP).(AdN)^{-1})$ are significantly reduced in damaged needles. This is due to relatively higher levels of Psub(i) and of AMP. The results, although incomplete and preliminary, indicate metabolic alterations which have been described for other tissues in response to pollution by photooxidants.

8639 (KFK-PEF—4-Vol.1, pp 201-212) **Micromethod for the determination of sulphite in needle tissue.** Keil, R.; Hampp, R.; Ziegler, H. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

A micromethod for the fluorometric determination of sulphite is presented. This method is based on a coupled enzyme assay, the product of which (NAD) is amplified by enzymatic cycling. With extracts of lyophilized needle tissue (Picea abies) the lower limit of detection was 0.5 pmol.

8640 (KFK-PEF—4-Vol.1, pp 213-224) **Tritium based investigations into the water transport and water turnovers in spruce trees.** Strack, S.; Unger, H. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Using tritium as the radioactive tracer it has been demonstrated that the water conveying system in the xylem of diseased spruces is disturbed. Whereas in the healthy tree the injected tritium containing water, which follows the spindle type grow of the ligneous fibers, is spread in the apex in a distinctly differentiated manner, this can no longer be detected in the ailing tree. With the additional finding that in the ailing tree the rate of migration of the labeled water molecules is about twice that in the healthy tree, this leads to the conclusion that the water conducting cross section is reduced in the diseased tree. The same conclusion was reached in investigations relating to cut off branches. In contrast to the tissue water of the needles of ailing trees, the tissue water of needles of healthy trees showed a distinct gradation of the tritium concentrations according to the age. It is concluded from this finding that in the healthy needles an age specific regulation of the stomata exists whereas this is no longer the case in the diseased needles.

8641 (KFK-PEF—4-Vol.1, pp 225-237) **Microorganisms as biological indicators of air pollution and resulting forest damage.** Waldner-Sander, S.; Botzenhart, K. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Staphylococcus epidermidis, Serratia marcenscens, Micrococcus luteus and the yeast Candida albicans are tested for their function as bioindicators in forest damage. Adsorbed at membranefilters, the organisms are exposed to the open air. Damage in metabolism or in reproduction capacity caused by gaseous air pollutants can be detected after a few hours. The kill speeds are determined by means of surviving, colony forming units and compared with nonexposed controls. The tenacity of organisms is clearly dependant on various compounds present in the air. There is no measurable effect in samples of air from rainy days with low level of air pollutants. In warm and dry periods, when photooxidants can be formed, the viability decreases in a significant way. Ozone and nitrogen oxides have a synergistic adverse effect on the organisms. Different kill speeds can be detected on the three sites of exposition. These results suggest that the use of microorganisms will be a quick method to describe the toxicity of air, containing unknown chemical compounds. Microorganisms can detect short periods of heavy air pollution and they are not depending on the site of exposition and the season. In addition to this studies the germ flora spectrum on the surface of leaves and needles in relation to the airborne organisms is examined.

8642 (KFK-PEF—4-Vol.1, pp 239-258) **Experiments on the effects of air pollutants on mineral cycling of forest trees.** Seufert, G.; Arndt, U. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

We suppose, that the main ecological process, which is affected by the changed chemical environment of forest ecosystems, is mineral cycling. The assumption is verified in a long-term experiment with young fir, spruce and beech trees in model/ecosystems. After two years of chronic fumigation with SO_2, O_3, SO_2+O_3 and application of simulated acid rain with pH 4,0 we find the following effects, which can be observed in a similar way in diseased forests: - Dry deposition of SO_2 causes elevated concentrations of sulphate and acid in throughfall, together with elevated Mg and Ca; - elevated acid input to the soil causes increased concentrations of SO_4^{2-}, H^+, Mn^{2+}; Ca^{2+} and Mg^{2+} in the lysimeter solutions; - in the leaves S- and Mn-contents are elevated, Mg and Ca are lowered; - until now, there is no clear influence of ozone alone to the mineral content of leaves, throughfall or soil solution; - there is clear evidence however, that SO_2-driven effects are intensified by simultaneous application of ozone. For example, in this case we find a raised and accelerated turnover of sulphur. The fumigation experiments in open-top-chambers with lysimeters are part of an experimental chain, integrating similar measurements in different forest stands as well as in opentop chambers around 12 year old spruce in a diseased forest area.

8643 (KFK-PEF—4-Vol.1, pp 259-273) **Feasibility study on experiments with open top chambers (OTC) to assess the effects of various air pollutants on health and growth of forest trees.** Kenk, G.; Gallus, M.; Hungar, U. Apr 1986. (In German). NTIS (US Sales Only), PC A20/MF A01. File Number DE87750294. (CONF-8603154—Vol.1).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

This research project is aimed at the technical and scientific preparation of a large-scale project utilizing open top experimental chambers ('OBOE'). The purpose of 'OBOE' is to analyse effects of certain air pollutants on health and growth of forest trees. The technological concept of OTCs has up to now been adapted mainly to the requirements of agricultural research. There is hardly any information available on the suitability of OTCs for forest trees. OTCs for forest research will have to be significantly larger than those presently used in agricultural environments, and they should be operational all year. This report is to introduce two chamber designs, which will be tested in a damaged forest area of the southern Black Forest beginning in spring 1986. In cooperation with a scientific advisory panel a preliminary research program for the 'OBOE'-project has been proposed. Further experiments could be integrated into this program. Final decisions should be made when the OTC tests have been completed successfully.

8644 (KFK-PEF—4-Vol.3, pp 851-862) **Possible consequences of forest decline. Ecological and political point of view.** Niesslein, E.; Tampe-Oloff, M. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The interdependence of infrastructural efficiency of the forest on specific constituent attributes has been analyzed in the light of results achieved by forest ecological examinations. By the help of an expert consultation it has been possible to establish the relation to the actual forest damage situation. Thus follows that the greatest impairment of the functions generally originates on the opening-up of stands, while less importance is ascribed to the elements crop age, stand stratification and composition of tree species. Besides the stand injury, the harmful substance burden in the air and soil are of decisive importance on the function of the forest as biotope for plants and animals. The drawn-up impairment chart seems to be suitable, when applicated on concrete crop situations, to signalize a endangerment of infrastructural functions through stand modification or damage intensity. Such a danger warning contributes to the fact that appropriate silvicultural, ecotechnical and environment political measures may be taken in order to assure the respective functions.

8645 (KFK-PEF—4-Vol.3, pp 909-931) **Effect of hyperoxia, ozone and nitrogen oxide on lung cells.** Ebert, W.; Paul, K.; Moll, E.; Werling, H.O.; Schoenberger, O.L.; Vogt-Moykopf, I. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Air pollutions, photooxidants and reactive oxygen species generated by host defence cells of the respiratory tract cause injury of the lung tissue. A common feature of these substances is their oxidative effect. In our experiments hyperoxic exposure of in vitro cultivated endothelial cells results in a decreased release of 6-keto-PGFsub(1α) an arachodonic acid metabolite. In addition, electron microscopic examinations revealed prominent damage of the ultrastructural appearance of these cells. Retractions, autophagy and atypism of cytoplasmic organelles and of the nucleus are observed.

8646 (KFK-PEF—4-Vol.3, pp 933-946) **Effect of SO_2, NO_2 and O_3 induced damage of bronchial epithelium on sensitization by inhaled allergens.** Riedel, F.; Kraemer, M.; Scheibenbogen, C.; Schauer, U.; Rieger, C.H.L. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The effect of sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and Ozone (O_3) induced damage of bronchial mucosa on local sensitization to inhaled antigens was studied in the guinea pig. After application of the irritant gases (on 5 days for 2 and 8 hours) ovalbumin (1% - 0.5% - 0.1%) was inhaled as antigen. On repeated ovalbumin inhalation after 7-21 days bronchial obstruction was investigated by plethysmographic lung function measurements (compressed air). After inhalation with SO_2 bronchial reaction was observed earlier and more pronounced than in the control group. Constant SO_2 concentrations and possible presensitization by oral route are discussed as methodical problems.

8647 (KFK-PEF—4-Vol.3, pp 947-958) **Analysis of bronchio-alveolar proteins as indicators of a cell alteration in lung tissue by inhalative noxious agents.** Mueller, B.; Weins, C.; Wichert, P. v. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

The study is designed to develop indicators of cell alterations, at first in animal experiments, by analysis of secretory products of the terminal airways. Inhalations with SO^2 and NO^2 are used in defined concentrations for one to three days. Serumidentical and specific lung proteins as well as phospholipids are measured in bronchoalveolar lavage. Preliminary results show a decrease in phosphatidylcholine and palmitic acid on this compound although these experiments were done with rather small inhalative burdens. We suggest that higher concentrations of toxic inhalations will lead to more marked effects particular in the protein fraction.

8648 (KFK-PEF—4-Vol.3, pp 959-973) **In vitro and in vivo studies of the carcinogenic, toxic and genotoxic activities of the air pollutants SO_2 and NOsub(x), separately and in combination with carcinogenic polycyclic aromatic hydrocarbons and N-nitrosamines.** Pool, B.L.; Klein, R.G.; Schmezer, P.; Zeller, W.J. Apr 1986. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298. (CONF-8603154—Vol.3).

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

Local and systemic effects of various air pollutants will be investigated in long term carcinogenicity assays in the rat. Simultaneously, cells will be explanted after in vivo pretreatment with SO_2/NOsub(x), alone or in combination with carcinogens, and will subsequently be assayed in vitro for cytotoxicity, genotoxicity and level of DNA repair. To assess the susceptibility of cells of the respiratory system in earlier phases of development, the combination effects of carcinogenic aromatic hycrocarbons and SO_2/NOsub(x) will be analyzed on fetal hamster lung cells in vitro.

8649 (LBL—20261, pp 10-11) **Effects of hydrogen peroxide in mist on trees.** Slanina, J.; Mallant, R.K.A.M.; Kettrup, A.; Masuch, G. (Universitaet G.H., Paderborn, West Germany). Nov 1985. NTIS, PC A06/MF A01. File Number DE86009469. (CONF-851077—Summs.).

From Symposium on heterogeneous processes in source-dominated atmospheres; New York, NY, USA (8 Oct 1985).

A correlation between exposure to mists and clouds and tree die-back was already observed some years ago in western Europe, but laboratory experiments indicated that only mists with a pH of 3 or lower will cause damage to leaves or needles. On the basis of this evidence, ECN and the Universitaet of Paderborn decided to investigate the effects of oxidants, notably H_2O_2, on mist and cloud droplets. In this experiment, spruce and beech were exposed to mist in two chambers. In one chamber an average composition containing about 100 micromoles of hydrogen peroxide was generated. In the second, the same mist was generated but without hydrogen peroxide. After a period of 6 weeks, the leaves and needles were investigated by means of microscopy techniques. The leaves and needles of trees exposed to hydrogen peroxide contained more stomata, showed a higher ratio of intercellular space/cell volume, and indicated changes in cell metabolism. Many of the changes caused by exposure to hydrogen peroxide have been observed in damaged forests in Western Germany.

8650 **(PB—86-241007/XAB) Lead exposures in the human environment. Final report.** Elias, R.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). 1985. 32p. (EPA—600/D-86/185). NTIS, PC A03/MF A01.

Published in Dietary and Environmental Lead: Human Health Effects, 79-107, 1985.

Humans consume lead by inhaling air, drinking beverages, eating food and ingesting dust. The natural source of this lead is primarily soil. Anthropogenic sources are lead in gasoline, fossil fuels and industrial products and processes. Lead is ubiquitous in the human environment, and pinpointing the primary sources of lead in any particular environmental component is difficult. Nevertheless, our purpose is to describe the total exposure of humans to environmental lead and to determine the sources of lead contributing to this exposure. The total exposure is the total amount of lead consumed by ingestion and inhalation. Excluding lead exposure from choice or circumstance, a baseline level of potential human exposure can be defined for a normal individual eating a typical diet and living in a non-urban community remote from industrial sources of lead in a house without lead-based paints. Beyond this level, additive exposure factors can be determined for other environments (e.g. urban, occupational and smelter communities) and for certain habits and activities (e.g. pica, smoking, drinking and hobbies), with variation for age, sex or socioeconomic status.

8651 **Effects of chronic topical application of 12-O-tetradecanoylphorbol-13-acetate on the skin and internal organs of SENCAR mice.** Klein-Szanto, A.J.P.; Conti, C.J.; Aldaz, C.M.; Clapp, N.; Nesnow, S.; Slaga, T.J. (Univ. of Texas System Cancer Center, Smithville). *Environmental Health Perspectives;* **68**: 75-80(Sep 1986). Contract W-7405-ENG-26.

Repetitive topical applications of 2 μg 12-O-tetradecanoylphorbol-13-acetate (TPA) twice weekly for 37 to 52 weeks induced a sustained epidermal hyperplasia of hair follicles, and increased dermal cellularity in SENCAR mice. In addition, after 52 weeks of protracted promoter treatment most animals developed generalized amyloidosis involving liver and spleen, as well as interstitial nephritis. Severe pyelonephritis and papillary necrosis were also frequently seen. Reactive lymphoid hyperplasia was also a frequent finding. Chronic administration of TPA is not an innocuous treatment affecting only the interfollicular epidermis. The general effect of the promoter on the animals was a marked decrease in their longevity, probably through impairment of the immune system.

8652 **Simulating fish exposure to toxicants in a heterogeneous body of water.** Breck, J.E.; DeAngelis, D.L.; VanWinkle, W. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 451-455 of Proceedings of the 1986 summer computer simulation conference. Crosbie, R.; Luker, P. San Diego, CA; Society for Computer Simulation (1986). (CONF-860729—). Contract AC05-84OR21400.

From Summer computer simulation conference; Reno, NV, USA (28 Jul 1986).

A model for individual fish has been applied to investigate factors influencing the variability of exposure and mortality in a fish population in a hypothetical small lake subjected to acute inputs of a toxicant. The model simulates the typical movement of a large number of individual fish in the lake in hourly timesteps by using a time-varying biased random walk on a two-dimensional grid. Intrusion of a toxicant into the lake is simulated as varying both spatially and temporally. In these simulations the fish are exposed to two pulses of acidified water, as might occur during two successive snowmelts in spring. Using this model, fish survival is evaluated in response to differences in avoidance behavior and in physiological damage-repair rate. Fish survival increased nonlinearly with decreases in the threshold concentration that initiates avoidance and with increases in the damage-repair rate, which indicates the importance of both behavioral and physiological factors for survival in a heterogeneous water body.

5604 Other Environmental Pollutant Effects

8653 **(AD-A—172458/2/XAB) Mechanisms of retinal damage from chronic laser radiation. Annual report, 1 September 1973-31 October 1976.** Lawwill; Crockett, S.; Currier, G.J. (Louisville Univ., KY (USA). Dept. of Ophthalmology). Nov 1976. 37p. NTIS, PC A03/MF A01.

The effect upon the retina of exposure to large fields of bright visible light was evaluated. The thresholds for retinal damage for four-hour exposures in rhesus monkeys were established for white light, argon laser lines of 514.5 nm, 488 nm, and 457.9 nm, and for 590 nm light from a dye laser. The damage was evaluated by ophthalmoscopy, electroretinography, light, and electron microscopy. The 457.9-nm light is more effective in causing damage, particularly histological damage, which is spread throughout the fundus and throughout the retinal layers. Functional damage shown by the electroretinogram follows a different spectral sensitivity curve without the increased effect in the blue. There appears to be more than one mechanism for retinal damage in chronic light exposure, and at least one mechanism is not dependent upon the visual pigment or the pigment epithelium. Thresholds appear to be within one or two log units of light levels encountered in normal visual experience. The model here considers exposing most of the posterior pole to an even illumination of moderately bright light for a period of hours. Thermal damage caused by small spot laser burns and photocoagulation is not the object; rather it is shown. That not only is the threshold lower with blue light, but that the morphological changes are different from those previously described. Primary damage occurs in retinal layers thought of as transparent to the damaging wavelength.

8654 **(DOE/BP/21216—1) Joint HVDC agricultural study: annual progress report for the 1985 study period.** Raleigh, R.J. (Oregon State Univ., Corvallis (USA)). Feb 1986. Contract AI79-85BP21216. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87002219.

This report describes the first year of a 3-year study designed to assess the possible environmental effects of a +-500-kV dc transmission line. This first annual report documents site development, initiation of the livestock and crop studies, and the integration and interfacing of the agricultural and BPA's electrical monitoring study. The overall objective is to assess whether operation of a +-500-kV dc transmission line results in any detectable effects (beneficial or adverse) on plants or livestock, under controlled, simulated farming and ranching conditions. These two biological systems were selected because they can be expected to experience long-term exposure to maximum field and ion concentrations on the transmission right-of-way. This study is designed to provide data on end points and parameters of primary interest in commercial farming and ranching operations.

8655 **(NP—7750350) Biological effects of electric and magnetic fields generated by power transmission lines.** (Statens Energiverk, Stockholm (Sweden)). Apr 1986. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750350.

The National Energy Administration shall give a yearly report to the Swedish Government on questions concerning biological effects generated by power transmission lines. This is the first publication within this series. The report gives basic information about electrical and magnetical fields. Exposed groups are presented. Effects of electrical and magnetical fields on man and other living organisms are described. Ongoing research in Sweden and in other countries are presented and commented. Future research activities are suggested. (BoK).

57 Health And Safety

REFER ALSO TO CITATION(S) 7917

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 7898, 7978, 7979, 7981

8656 **(DOE/ER/60197—2) On the surging potential of polar ice streams: Part 1, Sliding and surging of large ice masses: A review.** McInnes, B.; Radok, U.; Budd, W.F.; Smith, I.N. (Melbourne Univ., Parkville (Australia). Dept. of Meteorology). 1985. Contract AC02-84ER60197. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002539.

The main features of glacier surges were well known by the time the first detailed glacier dynamics and ice flow law came into being during the 1950s. The surging potential of polar ice streams raises additional questions which remain to be answered by a combination of observations and model refinements. This report reviews the available evidence on glacier sliding, and the main concepts and hypotheses that have been advanced for the surging phenomenon.

8657 **(DOE/ET/12139—T1) Tioga Bentonite in the Appalachian basin: Final report.** Dennison, J.M. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology). Nov 1986. Contract AS05-76ET12139. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002434.

The Tioga Bentonite is an interval up to 258 ft (79 m) thick with several tuff layers. It is present throughout nearly all of the central and northern portion of the Appalachian basin, but is missing in the southern Appalachian basin because of the unconformity at the base of the Chattanooga Shale. In parts of the southern Ohio outcrop belt the Tioga Bentonite is uncomformably omitted by overstep of the Ohio Shale, as is true in the Kentucky outcrops on the west side of the Appalachian basin. The Tioga Bentonite also occurs in the Illinois basin, where it is called by the same name in southwestern Indiana, Illinois, and western Kentucky. In the Michigan basin the Kawkawlin Bentonite is probably the same bed as the Tioga Bentonite middle coarse zone of the Appalachian basin. The top of the Tioga middle coarse zone marks the top of the Onesquethaw Stage of the Devonian System throughout 102,000 sq mi (265,000 sq km) in the Appalachian basin. The base of Devonian shales is diachronous in the Appalachian basin, occurring about 530 ft (160 m) below the Tioga middle coarse zone in northeastern Virginia, and about 45 ft (14 m) above the Tioga middle coarse zone in central Ohio. This report lists well and outcrop data for 763 localities where the Tioga Bentonite has been identified in the Appalachian basin. A series of detailed stratigraphic cross sections of the Tioga ash beds shows the internal stratigraphy of the Tioga Bentonite and its relation to overlying and underlying strata.

5802 Geophysics

REFER ALSO TO CITATION(S) 8214

8658 (BMI/ONWI—596) Interpretation of seismic reflection data, Central Palo Duro Basin: Technical report. (Long (G.J.) and Associates, Inc., Houston, TX (USA)). Nov 1986. Contract AC02-83CH10140. 47p. NTIS, PC E07/MF $7.55; 1; GPO Dep. File Number DE87002980.

Seismic reflection data from the Central Palo Duro Basin, Texas, were studied to identify and characterize geologic structure, potential hydrocarbon traps, and anomalies suggesting adverse features such as salt dissolution or diapirism. The data included seismic reflection data, geologic and geophysical data controlled by Stone and Webster Engineering Corporation, and data from the literature. These data comprised approximately 590 line-mi of seismic profiles over approximately 4000 mi^3, plus well logs from 308 wells. The study addressed the section from shallow reflectors down to basement. Structural contour maps were prepared for the Upper San Andres, Near Top of Glorieta, Wolfcamp, and Precambrian horizons. Isopach maps were prepared for intervals between the Upper and Lower San Andres and between the Upper San Andres and the Wolfcamp. Interpretation indicates southeasterly dips in the northwest part of the mapped area and southwesterly dips in the southwest part. Geologic structures show a generally northwest alignment. Faults at the Precambrian level and geologic structures show a generally northwest alignment. Faulting in the area is largely limited to the Precambrian, but interpretation is uncertain. Evidence of post-Wolfcampian faulting is not recognized. Seismic data delineating the San Andres section indicate a stable section throughout the area. Anomalous reflection events possibly associated with subsurface salt dissolution were seen at the 800- to 1200-ft level in Swisher County. Other anomalies include an overthickened zone northwest of Westway and carbonate buildup in the Wolfcamp and Pennsylvanian in Randall County. Mississippian to Middle Pennsylvanian diastrophism resulting in the Amarillo Uplift and Matador Arch is not manifested structurally in the central Palo Duro Basin. Subsidence or gentle uplift contributed to some structural deformation.

8659 (DOE/ER/13014—T2) Earthquake analyses for structural definition and material characteristics of the Mono Craters and Long Valley magma systems. Volume 1. Final report. (Woodward-Clyde Consultants, Pasadena, CA (USA)). [1986]. Contract AC03-82ER13014. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002323.

This report presents the results of research undertaken to increase understanding of the tectonic and magmatic processes occurring in the Long Valley and Mono Craters regions of California. The studies performed were of four different types. The first were based on a seismic data collection effort carried out at Long Valley. Both reflected and screened arrivals were searched for with essentially negative results. The second category of investigations carried out were intensive studies of important large earthquakes that have occurred in the Long Valley region. Some evidence indicates that, rather than being caused by slip on a fault plane, they were caused by magma injection. The third types of studies involved statistical analyses of seismicity data. The final studies involved the development of some important new theoretical methods for modeling the effects of screening bodies, such as magma bodies, on three dimensional wave fields.

8660 CSAMT method for determining depth and shape of a sub-surface conductive object. Lee, D.O.; Montoya, P.C.; Wayland, J.R. Jr. (to Dept. of Energy, Washington, DC). US Patent 4,616,184. 7 Oct 1986. Filed date 27 Jun 1984. vp.

A method is described for determining from ground surface the size and depth of an underground conductive object, the method comprising the steps of: transmitting a first CSAMT signal into the ground at a first location, the frequency of the signal being swept continuously from a low frequency to a higher frequency; receiving the first CSAMT signal at each of a plurality of receiving locations spaced from the first location; and determining the frequency at which a plot of apparent resistivity at any location as a function of frequency indicates an abrupt increase in apparent resistivity in the form of a peak; and determining the depth of the underground object from the frequency at which the peak occurs; the depth being equal to one-fourth the wavelength in the ground material at the frequency.

8661 Investigation of subsurface structure with borehole gravimetry. Hearst, J.R. Littleton, CO; Society of Mining Engineers of AIME (1985). 11p. (CONF-851054—). Society of Mining Engineers of AIME, Caller No. D, Littleton, CO 80127. Contract W-7405-ENG-48.

From Society of Mining Engineers fall meeting; Albuquerque, NM, USA (16 Oct 1985).

Conventional logging tools such as density, neutron, and acoustic have ranges of investigation of tens of centimeters. The borehole gravimeter, however, has a range up to hundreds of meters. For example, from the center of a cylindrical orebody 0.22 g/cm/sup 3/ denser than its surroundings, one can detect the boundary of the orebody at a radius as large as five times its height. More complex structures can be investigated with computer programs. One can predict the usefulness of proposed gravity surveys, or decide which suggested structure is most likely to have caused the results of existing surveys.

8662 Probabilistic analysis of seismic safety against liquefaction. Pires, J.E.; Wen, Y.K.; Ang, A.H. (Brookhaven National Lab., Upton, NY). pp 159-165 of Proceedings of the eighth world conference on earthquake engineering. Volume 3. Old Tappan, NJ; Prentice Hall, Inc. (1984). (CONF-840703—).

From 8. world conference on earthquake engineering; San Francisco, CA, USA (21 Jul 1984).

Liquefaction of sand deposits during earthquakes is studied as a problem of random vibration of hysteretic systems in which the random nature of the seismic ground motions, and the nonlinear soil response behavior are properly accounted for. It is assumed that liquefaction will occur when the excess pore pressure becomes equal to the initial effective vertical stress, i.e. when the sand stiffness has deteriorated to zero. The random vibration results and the uncertainty analysis of the soil properties are used to calculate the reliability of sand deposits against liquefaction under a random seismic loading with a given intensity and duration.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 7929, 7980

8663 (LA-UR—86-1931) Micro-mechanics of cemented granular material. Trent, B.C.; Margolin, L.G.; Cundall, P.A.; Gaffney, E.S. (Minnesota Univ., Minneapolis (USA). Dept. of Civil and Mineral Engineering; Lawrence Livermore National Lab., CA (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-870103—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012386.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

We have shown that a distinct element numerical model is of significant value in understanding macroscopic behavior. Specific constitutive relations are under development and utilize many of the parameters described here, including average bond damage and the formation and evolution of particle clusters. Numerical experiments such as these, along with physical tests, will provide great insight into the behavior of geologic materials.

8664 (SAND—85-7107) Suitability of natural soils for foundations for surface facilities at the prospective Yucca Mountain Nuclear Waste Repository. Ho, D.M.; Sayre, R.L.; Wu, C.L. (Bechtel National, Inc., San Francisco, CA (USA)). Nov 1986. Contract AC04-76DP00789. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003091.

In this report, the natural soils at the Yucca Mountain site are evaluated for the purpose of assessing the suitability of the soils for the foundations of the surface facilities at the prospective repository. The areas being considered for locating the surface facilities are situated on an alluvial plain at the base of Yucca Mountain.

Preliminary parameters for foundation design have been developed on the basis of limited field and laboratory study of soils at four test pit locations conducted during May and June 1984. Preliminary recommendations for construction are also included in this report. The gravel-sand alluvial deposits were found to be in a dense to very dense state, which is suitable for foundations of the surface facilities. The design parameters described in this report have been developed for conceptual design, but need to be verified before final design.

8665 **(SAND—85-7261) Triaxial compression creep tests on salt from the Waste Isolation Pilot Plant: Topical report.** Senseny, P.E. (RE/SPEC, Inc., Rapid City, SD (USA)). Oct 1986. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002633.

Twenty-six triaxial compression creep tests were performed on argillaceous and clean salt from the Waste Isolation Pilot Plant. The average water- and EDTA-insoluble content of the argillaceous salt was 1.5 and 0.75%, respectively. This small quantity of impurities corresponded to consistent, but small, increases in the deformation measured during the tests. Results of these tests are similar to those obtained previously with two exceptions. The first is that the stress dependence of the steady-state strain rate at 25°C is greater than reported previously. The second is that the temperature dependence of the transient strain limit appears to be greater than reported previously.

8666 **(SAND—86-0074C) Implementation of a finite element damage model for rock.** Costin, L.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 4 Jun 1986. Contract AC04-76DP00789. 24p. (CONF-870103—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014152.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

A continuum damage model based on the mechanics of microcrack growth has been implemented in the finite element code SANCHO. The model incorporates the effects of the nucleation, growth and coalescence of microcracks under compressive loading. The material subroutine keeps track of both the magnitude and direction of microcrack growth in each element so that the induced anisotropy due to crack growth in preferred directions and the stress history dependence of microcrack growth are properly taken into account. In addition, the model allows for interaction among neighboring microcracks which leads to coalescence and subsequent material failure or softening. A damage vector, which is calculated from the crack distribution in each element, is used as an internal variable to compute the effective elastic moduli at each stage of the deformation. Several sample calculations using the model with material parameters chosen to represent Westerly granite were performed to demonstrate the model's capability and to investigate problems where structural failure occurs in a controlled manner.

8667 **Gas fracturing: Numerical calculations and field experiments.** Griffiths, S.K.; Smith, C.W.; Nilson, R.H. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). pp 157-164 of Rock mechanics in productivity and protection. Dowding, C.H.; Singh, M.M. New York, NY; American Institute of Mining, Metallurgical and Petroleum Engineers (1984). Contract AC04-76DP00789.

A general method-of-lines numerical approach for modeling gas driven fractures has been developed and tested. The numerical solutions agree very well with known similarity solutions for laminar and turbulent flow. Acceptable accuracy is obtained with a very few numerical grid points and with modest execution times. The model has also been checked against the results of several field tests, in which air was used to drive axisymmetric fractures into permeable tunnel-bed tuff.

8668 **Numerical and physical studies of fluid-driven fracture propagation in jointed rock.** Shaffer, R.J.; Thorpe, R.K.; Ingraffea, A.R.; Heuze, F.E. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 117-126 of Rock mechanics in productivity and protection. Dowding, C.H.; Singh, M.M. New York, NY; American Institute of Mining, Metallurgical and Petroleum Engineers (1984). (CONF-840633—).

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

Hydraulic fracturing in rock masses involves complex and coupled processes of fractures propagating in discontinuous media and of fluid flow in discrete channels. The Unconventional Gas Program at LLNL is actively developing numerical models to gain insight in the physics of these coupled processes. This paper describes the current status of the FEFFLAP code, which models fluid-driven discrete fracture propagation in jointed media. The authors also discuss the results of a preliminary series of physical tests in which hydrofractures were driven across slanted interfaces between dissimilar materials, in blocks loaded in biaxial compression.

8669 **A criterion for quasibrittle crack growth.** Margolin, L.G.; Smith, B.W. (Los Alamos National Lab., Los Alamos, NM). pp 21-28 of Rock mechanics in productivity and protection. Dowding, C.H.; Singh, M.M. New York, NY; American Institute of Mining, Metallurgical and Petroleum Engineers (1984). (CONF-840633—).

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

In this paper the authors derive an expression to predict the onset of growth of a crack in a quasibrittle material. They employ an energy criterion, which was first proposed in a previous work, and is essentially equivalent to the first two laws of thermodynamics. The criterion is applied to the elastic-plastic crack which is a three-dimensional generalization of the an earlier studied crack. The authors' expression for the onset of growth differs in several respects from a criterion based on a crack in a brittle material (i.e., using linear elastic fracture mechanics). Furthermore, the new features are in qualitative agreement with the experimental data. Among these new features are as follows: 1) the dependence of the apparent surface energy, or critical strain energy release rate on crack size (the shape of the R-curve); 2) the effect of in-plane stresses (i.e., the stresses that do not lead to any traction on the crack faces) on crack growth; and 3) a brittle-ductile transition.

5805 Oceanography

REFER ALSO TO CITATION(S) 7942

64 PHYSICS I

6401 Astrophysics And Cosmology

8670 **(LBL—22343) ASTROMAG: A superconducting particle astrophysics magnet facility for the space station.** Green, M.A.; Smoot, G.F.; Golden, R.L.; Israel, M.H.; Kephart, R.; Niemann, R.; Mewalt, R.A.; Ormes, J.F.; Spillantini, P.; Widenbeck, M.E. (Lawrence Berkeley Lab., CA (USA); New Mexico State Univ., Las Cruces (USA); Washington Univ., St. Louis, MO (USA); Fermi National Accelerator Lab., Batavia, IL (USA); California Inst. of Tech., Pasadena (USA); National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1986. Contract AC03-76SF00098. 8p. (CONF-860914—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002574.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

This paper describes a superconducting magnet system which is the heart of a particle astrophysics facility to be mounted on a portion of the proposed NASA space station. This facility will complete the studies done by the electromagnetic observatories now under development and construction by NASA. The paper outlines the selection process of the type of magnet to be used to

analyze the energy and momentum of charged particles from deep space. The ASTROMAG superconducting magnet must meet all the criteria for a shuttle launch and landing, and it must meet safety standards for use in or near a manned environment such as the space station. The magnet facility must have a particle gathering aperture of at least 1 square meter steradian and the facility should be capable of resolving heavy nuclei with a total energy of 10 Tev or more. 4 refs., 3 figs.

8671 (N—86-29752) Vertical thermal structure of the Venus atmosphere from temperature and pressure measurements. Linkin, V.M.; Blamon, Z.; Lipatov, A.P.; Devyatkin, S.I.; Dyachkov, A.V.; Ignatova, S.I.; Kerzhanovich, V.V.; Malyk, K.; Stadny, V.I.; Sanotskiy, Y.V. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1986. 9p. (NASA-TM—88420; NAS—1.15:88420). NTIS, PC A02/MF A01.

Translated from Pismma v AZh (USSR), 12: No. 2, 100-105(1986).

Accurate temperature and pressure measurements were made on the Vega-2 lander during its entire descent. The temperature and pressure at the surface were 733 K and 89.3 bar, respectively. A strong temperature inversion was found in the upper troposphere. Several layers with differing static stability were visible in the atmospheric structure.

8672 (N—86-30617) Preliminary results of determination of chemical element concentrations in the aerosol of Venus clouds. Andreychikov, B.M.; Mukhin, L.M.; Korchuganov, B.N.; Akhmetshin, I.K.; Tokarev, Y.N.; Medvedev, A.V.; Goldfeld, M.N.; Faynboym, V.M.; Kalyuzhnyy, A.V.; Petryanov, I.V. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1986. 7p. (NASA-TM—88423; NAS—1.15:88423). NTIS, PC A02/MF A01.

Translated from Pisma v AZh (USSR), 12, No. 2, 120-122(1986).

An x-ray radiometeric experiment is described along with the results of measurements of the elemental composition of aerosols in Venusian clouds. A preliminary analysis of the data showed that sulfur is present in the range of heights 63 to 47 km with mean content of 5.8 mg/cu m and that chlorine is present in the height range 61 t0 52 km with a mean content of 4.1 mg/cu m. The results of measurements in the range 52 to 47 km may come to an agreement if phosphorus is present in the aerosol with a mean concentration of 7.7 mg/cu m.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 8367

8673 (CERN-EP—86-128) Radioactive ion-beams available at on-line mass separators. Ravn, H.L. (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Sep 1986. 32p. (CONF-860815—9). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900152.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

Today new rapid separation methods, based on thermochemical and physical principles, allow radioactive nuclei of almost all elements to be continuously transferred from an accelerator target into an ion beam. These techniques often referred to as target and ion-source systems have in the last 20 years turned on-line mass separators into the most efficient tool for production and study not only of nuclei far from stability but radioactive nuclei in general. The present paper summarizes the status of this field in terms of elements available as ion beams, overall efficiency, intensity, selectivity and speed. By means of examples selected from the ongoing development work at many on-line separator laboratories the prospects for improving existing systems and extension to further elements are assessed. 84 refs., 15 figs.

8674 (CONF-861114—22) Synchrotron radiation inner-shell photoionization of atomic and molecular gases. Short, R.T.; O, C.S.; Levin, J.C.; Sellin, I.A.; Johnson, B.M.; Meron, M.; Jones, K.W.; Church, D.A. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA); Brookhaven National Lab., Upton, NY (USA); Texas A and M Univ., College Station (USA)). 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001825.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A time-of-flight (TOF) spectrometer has been used to measure the average kinetic energies of near thermal atomic and molecular ions, as well as energetic molecular ion fragments, produced by inner-shell photoionization of atomic and molecular gas targets using x rays from the National Synchrotron Light Source (NSLS). While atomic and molecular ions acquire very little energy from the initial photoionization event and subsequent vacancy cascades, multiply charged molecular ions decompose rapidly, producing fragment ions which have kinetic energies determined by their configuration at the moment of decomposition. The strong effects observed suggest that this technique may be extended to the study of configurations of free molecules as well as the orientation of molecules adsorbed on surfaces. 5 refs., 2 figs.

8675 (CONF-861114—24) Angular distributions of very low energy recoil ions. Gonzalez Lepera, C.E.; Breinig, M.; Burgdoerfer, J.; DeSerio, R.; Elston, S.B.; Gibbons, J.P.; Huelskoetter, H.P.; Liljeby, L.; Vane, C.R.; Sellin, I.A. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002408.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

We present the first measurements of the angular distribution of recoil ions near 90° with respect to the incident projectile direction. Beams of 22.5 and 33 MeV chlorine ions (incident charge states q =4,5,8) have been used as "hammer" beams incident on Ne atoms. We confirm the long standing assumption that these recoil ions are ejected preferentially at angles near 90° with respect to the primary beam direction and with energies typically less than 5 eV. Recoil ions ejected around 90° have an energy distribution appreciably wider than those ejected at either larger or smaller angles. 9 refs., 6 figs.

8676 (CONF-861114—25) Calculations of coincident ionization plus excitation. Becker, R.L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002402.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

For Li- and Be-like ions, K x-ray yields, together with detection that the ionic charge has increased, give the cross section for ionization plus excitation (IE), a process which can exhibit electron-electron correlations. Measurements of IE for $_{14}Si^{11+}$ + He stimulated our coupled-channels calculations in the independent-Fermi-particle model (IFPM), which includes Pauli correlations. We discuss how the IFPM expressions, generalized here to include an open shell, differ from those for distinguishable electrons. The sensitivity of σ/sub IE/ to correlations is shown. Recent additional measurements and future ones giving excitation functions for resolved configurations and complementary Auger data will provide even more sensitive tests of collisional correlation theory. 15 refs., 3 figs., 1 tab.

8677 (CONF-8610115—4) Fundamental processes in low energy collisions of alkali anions and atoms. Champion, R.L.; Doverspike, L.D.; Scott, D.M.; Wang, Y. (College of William and Mary, Williamsburg, VA (USA). Dept. of Physics). 1986. Contract AS05-79ER10371. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002705.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Negative ion sources often employ alkali metal atoms in one way or another in order to increase their yield. Models which describe equilibrium conditions or the nature of energy transport within these sources require, among other things, information about the two-body cross sections for various scattering channels which involve either alkali negative ions or alkali atoms. The purpose of this report is to provide a brief summary of recent experimental observations in which collisions of alkali anions (M^-) with various atoms and molecules and collisions of H^- and D^- with alkali atoms (M) have been investigated. The energy range of the experiments, $5 < E < 500$ eV, includes those kinetics energies often found in discharge-type ion sources. The specific experiments which will be discussed focus upon measurements of total cross sections for collisional electron detachment and charge transfer of negative ions. 16 refs., 7 figs.

8678 **(DOE/ER/45222—1) [Studies of the interaction of hydrogen with transition metal surfaces]: Technical progress report.** El-Batanouny, M. (Boston Univ., MA (USA)). 1986. Contract FG02-85ER45222. 27p. NTIS MF A01; 2; GPO Dep. File Number DE87002768.

In the past year we carried out detailed measurements of the elastic and inelastic scattering of He from the Cu(100) surface. These measurements were in effect a detailed evaluation of the performance of our novel metastable-atom-detector (MAD), allowing us to compare our elastic scattering data with previous results of Lapujoulade and coworkers; the surface phonon dispersion along the <110> and <100> directions were derived from the inelastic scattering measurements; the former was compared with the data of the Canadian group who measured the phonon dispersion along the <110> direction only; another comparison was made with the Cu(111) surface phonon dispersion reported by the Goettingen group. Furthermore, because of one of the unique features of our detector we were the first to perform inelastic scattering measurements out of the plane of incidence (other detectors do not have the necessary degree of freedom to make such measurements). We demonstrated that the surface phonon density of states could easily be mapped by such measurements.

8679 **(LBL—22316) Lectures on pulsed NMR.** Pines, A. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Chemistry). Sep 1986. Contract AC03-76SF00098. 161p. (CONF-860792—1). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002560.

From 100. Fermi school of physics; Varenna, Italy (8 Jul 1986).

These lectures discuss some recent developments in pulsed NMR, emphasizing fundamental principles with selected illustrative applications. Major topics covered include multiple-quantum spectroscopy, spin decoupling, the interaction of spins with a quantized field, adiabatic rapid passage, spin temperature and statistics of cross-polarization, coherent averaging, and zero field NMR. 55 figs.

8680 **(UCRL—15848) Description of a program to calculate the UTA configuration energies, widths and shifts.** Bar-Shalom, A.; Goldstein, W.; Lee, R. (Lawrence Livermore National Lab., CA (USA); Technical Research Center of Negev, Beersheba (Israel)). Sep 1986. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002506.

This program, AVERAGE, does the following: (1) It uses the parametric potential method to find the average configuration, having been given the chemical potential and the electron temperature. (2) It accurately calculates the energies of a set of configurations about the average configuration. This is done by converging a different potential to each configuration. (3) It calculates the widths and shifts of j-j transitions using the method developed by Bauch and Klapisch. The code has been programmed in order to be easy to use on the one hand, and on the other hand be highly efficient.

8681 **(UCRL—95414-Rev.1) Beam foil spectroscopy of $N = 3$ to $N = 2$ transitions in highly stripped heavy ions. Revision 1.** Dietrich, D.D.; Chandler, G.A.; Egan, P.O.; Ziock, K.P.; Mokler, P.H.; Reusch, S.; Hoffmann, D.H.H. (Lawrence Livermore National Lab., CA (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Sep 1986. Contract W-7405-ENG-48. 17p. (CONF-861114—26-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001353.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The spectroscopy of very highly ionized atoms provides an important testing ground for multi-electron atomic theory. We report preliminary experimental results on the $n = 3 \rightarrow 2$ spectra of Bi^{+73} and A^{+88} obtained at the GSI UNILAC accelerator. 19 refs., 4 figs.

6404 Fluid Physics

8682 **(SAND—85-2707) Numerical solutions to creeping flow equations: Part 1, Falling-ball rheometry.** Wagner, N.; Mondy, L.A.; Miller, J.D.; Graham, A.L.; Cook, W.A. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering; Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). Nov 1986. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002630.

Numerical solutions are described for the velocity and stress fields in a viscous Newtonian liquid contained in a cylindrical vessel during the passage of a solid sphere settling under the influence of gravity. By taking advantage of the mathematical analogy between incompressible creeping flow of a Newtonian liquid and incompressible elasticity in a Hookean solid, we use advanced, finite element, computer programs developed for solid mechanics to perform creeping flow calculations. The drag on the sphere, in an unbounded fluid, would be given by Stokes' law. Using finite element stress codes we calculate the additional drag on the sphere due to the presence of the containing walls of the cylinder and the upper free surface of the liquid. Good agreement with experimental data and with analytical calculations is obtained for a range of ball sizes. Our findings indicate that the finite element method is an accurate computational technique for solving this class of multiphase hydrodynamics problems. 34 refs., 6 figs.

8683 **(UCID—20915) Analysis of Rayleigh-Taylor flows using vortex blobs.** Kerr, R.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002836.

A modification of a boundary-integral method is used to study the single-scale Rayleigh-Taylor instability for arbitrary Atwood number. The modifications are designed to extend the calculation through several singular events. Smoothing the Green's function using vortex blobs suppresses singularities in the curvature. Second-order central differences along the interface are used to accommodate spikes in the vorticity. Spreading the nodes evenly along the interface can be used to suppress clustering of nodes. To achieve second-order accuracy in time when the nodes are spread an extra predictor step is needed that shifts the nodes before the variables are advanced. The method successfully follows the development of a single mode to states with asymptotic velocities for the bubble and spike that depend on Atwood number and are independent of the blob size. Incipient droplet formation is observed. 38 refs., 36 figs.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 8727

6451 Particle Interactions And Properties - Experimental

8684 **(ANL-HEP-CP—86-50) Upper limit on the D*(2010) decay width.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). Jun 1986. Contract W-31-109-ENG-38. 9p. (IUHEE—386; UM-HE—86-13; PU—86-571; CONF-860701—50). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001502.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

We report a measurement of the upper limit of the decay width for the $D^{*+}(2010)$ meson using the High Resolution Spectrometer at PEP. We observed the charged D^* production in the decay mode of $D^{*+} \rightarrow D^0\pi^+$ with the D^0 decaying into the $K^-\pi^+$ mode. The peak in the mass difference distribution $M(K^-\pi^+\pi^+)$-$M(K^-\pi^+)$ was used to directly measure the decay width. The width is dominated by the detector resolution and the preliminary result is an upper limit on the full width of Γ/sub D*/ < 1.15 MeV/c^2 at 90% C.L. 7 refs., 2 figs.

8685 **(ANL-HEP-CP—86-54) Multiplicity distributions in e^+e^- annihilation at 29 GeV: a comparison with hadronic data.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). Jun 1986. Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125. 16p. (IUHEE—383; UM-HE—86-10; PU—86-567; CONF-860701—47). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001501.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The charged particle multiplicity distributions for single jets in e^+e^- annihilation at 29 GeV have been measured using the High Resolution Spectrometer at PEP. The shape of the -distribution agrees well with a Poisson distribution. No correlation is observed between the multiplicities in the two jets of an event. For fixed values of the prong number of the total event, the multiplicity sharing between the two jets is in good agreement with a binomial distribution. These observations are contrasted to the results from soft hadronic collisions and conclusions are drawn about the nature of clusters. 21 refs., 4 figs.

8686 **(ANL-HEP-CP—86-55) Measurement of the electroweak asymmetry in the reaction $e^+e^- \rightarrow \tau^+\tau^-$ at 29 GeV.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). Jun 1986. Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125. 8p. (IUHEE—384; UM-HE—86-11; PU—86-568; CONF-860701—48). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001504.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This paper reports the electroweak asymmetry in the reaction $e^+e^- \rightarrow \tau^+\tau^-$ at 29 GeV. The results came from data taken with the High Resolution Spectrometer at PEP corresponding to an integrated luminosity of 256 pb^{-1}. The 7372 observed events give A/sub tau tau/ = -(4.4 +- 1.4 +- 0.5)%. Events selected in the central region of the detector measure a total cross section of R/sub tau tau/ = 1.06 +- 0.02 +- 0.04. 5 refs., 1 fig.

8687 **(ANL-HEP-CP—86-62) Measurement of the D^0 meson lifetime.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). 1986. Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125. 15p. (IUHEE—88; UM-HE—86-17; PU—86-574; CONF-860701—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001508.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

We report the measurement of the lifetime of the D^0 meson. The direct observation of the decay vertex distribution in the process $D^0 \rightarrow K^-\pi^+$ was made using a vertex chamber installed in the HRS detector at PEP. The measured lifetime is found to be tau/sub D*/ = .42 +- .09 +- .06ps. 5 refs., 4 figs.

8688 **(ANL-HEP-CP—86-70) Observation of tensor and scalar mesons produced in e^+e^- annihilation at 29 GeV.** Abachi, S.; Baringer, P.; Bylsma, B.G.; DeBonte, R.; Koltick, D.; Loeffler, F.J.; Low, E.H.; McIlwain, R.L.; Miller, D.H.; Ng, C.R. (Purdue Univ., Lafayette, IN (USA); Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Michigan Univ., Ann Arbor (USA); Lawrence Berkeley Lab., CA (USA)). 1986. Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125. 15p. (IUHEE—93; UM-HE—86-21; PU—86-577; CONF-860701—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001499.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The production of the tensor mesons, integral°(1270) and K*°(1430), and the scalar meson S(975) have been observed in e^+e^- annihilation at 29 GeV center of mass energy, using data obtained with the HRS detector at the PEP storage ring. The mean multiplicities for meson momenta greater than 1450 MeV/c are <n/sub f°/> = 0.11 +- 0.04, <n/sub K*°(1430)/> = 0.10 +- 0.06, and <n/sub S/> = 0.05 +- 0.02 per hadronic event. The fragmentation functions of the tensor mesons are in good agreement with the predictions of the Webber cluster model. The possibility of a large strange quark component in the S meson structure is suggested by the data.

8689 **(ANL-HEP-CP—86-71) Study of the F meson in e^+e^- collisions at 29 GeV.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). 1986. Contract AC03-76SF00098;AC02-76ER01112;W-31-109-ENG-38;AC02-76ER01428;AC02-84ER40125. 13p. (IUHEE—94; UM-HE—86-22; PU—86-578; CONF-860701—52). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001511.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Data from the High Resolution, Spectrometer at PEP have been used to study the inclusive production of F^{+-} mesons. The meson observed in the $F^+ \rightarrow phi\pi^+$ decay has a mass of 1965.9 +- 3 MeV for Z > 0.4. In this region of Z, assuming R(F)/(R(F) + R(D)) = 0.15, the $F \rightarrow phi\pi$ branching is (2.8 +- 1.0)%. 6 refs., 7 figs.

8690 **(ANL-HEP-CP—86-72) Search for spin-dependent effects in c-quark fragmentation.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.M.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Lawrence Berkeley Lab., CA (USA); Michigan Univ., Ann Arbor (USA); Purdue Univ., Lafayette, IN (USA)). 1986. Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125. 19p. (IUHEE—95; UM-HE—86-23; PU—86-579; CONF-860701—51). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001503.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Events of the reaction e^+e^- → c anti c at 29 GeV were isolated by observing D* mesons through $D^{*+} \rightarrow D^0\pi^+$ decay. The D^0 decay modes used are $D^0 \rightarrow K\pi$, $K3\pi$, and $K\pi(\pi^0)$. The data, which correspond to an integrated luminosity of 300 pb^{-1}, were collected by the High Resolution Spectrometer at PEP. All angular distributions examined are consistent with being isotropic; there is no evidence for D* alignment in the e^+e^- reaction. 6 refs., 9 figs.

8691 **(BNL—38729) Results of two scattering processes: $\pi\pi$ → phi phi and $\pi\pi$ → K anti K.** Longacre, R.S.; Chan, C.S.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Kramer, M.A.; Lindenbaum, S.J.; Love, W.A.; Morris, T.W.; Platner, E.D. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1986. Contract AC02-83ER40107;AC02-76CH00016. 5p. (CONF-860701—42). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002157.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

An analysis is presented of 6658 events of the reaction π^-p → phi phi n at 22 GeV/c. This data is well represented by three resonances, all with quantum numbers I/sup G/J/sup PC/ = 0^+2^{++}. In a second analysis, which consists of 40494 new events of the reaction π^-p → K/sub s/°K/sub s/°n at 22 GeV/c, we obtain the S_0, D_0 and G_0 Argand amplitudes for $\pi\pi$ → K anti K. The θ (1690) is shown to decay into $\pi\pi$ by less than 4% and only is required in J/psi radiative decay experiments.

8692 **(CERN-EP—85-07) Measurement of deep inelastic Compton scattering of high energy photons.** (European Organization for Nuclear Research, Geneva (Switzerland)). 18 Jan 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900239.

The first results are presented on inclusive photo-production of prompt photons at high transverse momenta. The data were taken in an open spectrometer at CERN using a high intensity photon beam with energy between 50 and 150 GeV. After subtracting the yield of photons from indirect sources, a clear excess is observed for transverse momenta above 2.5 GeV/c. Deep inelastic Compton scattering with appropriate QCD corrections account for this excess. The data disfavor the gauge integer charge quark models so far proposed. 14 refs., 5 figs.

8693 **(CERN-EP—86-124) Pomeron-Pomeron collisions at the CERN ISR [Intersecting Storage Rings].** Dallavalle, G.M. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Sep 1986. 8p. (CONF-8606203—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900151.

From Symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

Proton-proton interactions which result in a central cluster of mass M/sub x/ and two quasi-elastically scattered protons are generally described by Pomeron-Pomeron scattering. A study of this process at ISR energies with the SFM is carried out in terms of transverse momentum behaviour for the central system of particles. Events are observed in which high p/sub T/ particles are produced in the central system.

8694 **(SLAC-PUB—4092) Heavy leptons in 1986.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1986. Contract AC03-76SF00515. 7p. (CONF-860701—54). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002847.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The search for new leptons beyond the electron, muon, and tau generations is reviewed. Also discussed is an unexplored region in the mass ranges of leptons: small visible energy events in the electron-positron annihilation and close-mass pairs. 18 refs., 4 figs. (LEW)

6452 Particle Interactions And Properties - Theoretical

8695 **(BNL—38622) New results on the E(1420)/IOTA(1460) meson in hadroproduction.** Chung, S.U. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-860701—55). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002580.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A mini-review, with emphasis on new results, is given on the status of the hadroproduced E(1420)/iota(1460) meson in the decay channels eta $\pi\pi$ and K anti K π. The BNL data at twice the statistics of the previously published event sample show clearly a J/sup PG/ = O^{-+} δ (980)π state with a phase motion characteristic of a resonance. 10 refs., 6 figs.

8696 **(BNL—38774) ISAJET 5.30: A Monte Carlo event generator for pp and anti pp interactions.** Paige, F.E.; Protopopescu, S.D. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 7p. (CONF-8606215—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002391.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

ISAJET is a Monte Carlo program which simulates pp and anti pp interactions at high energy. It is based on perturbative QCD cross sections, leading order QCD radiative corrections for initial and final state partons, and phenomenological models for jet and beam jet fragmentation. This article describes ISAJET 5.30, which includes production of standard Higgs bosons and which will be released shortly.

8697 **(CERN-EP—86-121) Experimental tests of the Electroweak Theory.** Dydak, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Sep 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87900148.

The status of experimental tests of the Electroweak theory of Glashow, Salam, and Weinberg is reviewed, focusing on the principle of the experimental techniques, on the significance of the results, and on the likely future development. Topics covered include tests of quantum electrodynamics, neutrinos and their masses, quark mixing and CP violation, the structure of the weak charged current, weak neutral current processes, the W and Z bosons, and electroweak physics at LEP/SLC and HERA. 174 refs., 53 figs. (LEW)

8698 **(DOE/ER/03244—125) Strange matter and dihyperon physics.** Barnes, P.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1986. Contract AC02-76ER03244. 14p. (CONF-860575—60). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002034.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A short review of the properties of Strange Matter is followed by a discussion of dihyperon physics. Calculations of the mass, lifetime and decay modes of the H particle are discussed, along with a review of experiments designed to search for the H Dibaryon. 32 refs., 15 figs.

8699 **Effective strong coupling lattice model for finite temperature QCD.** Gocksch, A.; Ogilvie, M. (Brookhaven National Lab., Upton, NY). *Physics Letters [Section] B;* **141B**: No. 5-6, 407-410(5 Jul 1984). Contract AC02-76CH00016.

The authors present a strong coupling lattice model for finite temperature QCD. It is shown to contain what are thought to be the essential features of the underlying theory: at a finite physical temperature T/sub D/ the authors observe the remnants of the deconfining phase transition. At low temperatures chiral symmetry is broken but is restored at a temperature T/sub ch/ > T/sub D/. The zero temperature spectrum is computed and estimates for T/sub CH, T/sub D/ are given.

6454 Field Theory

8700 **(DOE/ER/40272—20) Field theory of strings.** Ramond, P. (Florida Univ., Gainesville (USA). Dept. of Physics). 1986. Contract FG05-86ER40272. 21p. (CONF-8606233—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002445.

From 2. nobel symposium on elementary particle physics; Marstrand, Sweden (2 Jun 1986).

We review the construction of the free equations of motion for open and closed strings in 26 dimensions, using the methods of the Florida Group. Differing from previous treatments, we argue that the constraint $L_0 - \bar{L}_0 = 0$ should not be imposed on all the fields of the closed string in the gauge invariant formalism: we show that it can be incorporated in the invariant formalism at the price of being unable to extract the equations of motion from a Lagrangian. We then describe our purely algebraic method to introduce interactions, which works equally well for open and closed strings. Quartic interactions are absent except in the Physical Gauge. Finally, we speculate on the role of the measure of the open string path functional. 20 refs.

8701 **(LBL—22303) Continuum regularization of quantum field theory.** Bern, Z. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Physics). Apr 1986. Contract AC03-76SF00098. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87002549.

Possible nonperturbative continuum regularization schemes for quantum field theory are discussed which are based upon the Langevin equation of Parisi and Wu. Breit, Gupta and Zaks made the first proposal for new gauge invariant nonperturbative regularization. The scheme is based on smearing in the "fifth-time" of the Langevin equation. An analysis of their stochastic regularization scheme for the case of scalar electrodynamics with the standard covariant gauge fixing is given. Their scheme is shown to preserve the masslessness of the photon and the tensor structure of the photon vacuum polarization at the one-loop level. Although stochastic regularization is viable in one-loop electrodynamics, two difficulties arise which, in general, ruins the scheme. One problem is that the superficial quadratic divergences force a bottomless action for the noise. Another difficulty is that stochastic regularization by fifth-time smearing is incompatible with Zwanziger's gauge fixing, which is the only known nonperturbaive covariant gauge fixing for nonabelian gauge theories. Finally, a successful covariant derivative scheme is discussed which avoids the difficulties encountered with the earlier stochastic regularization by fifth-time smearing. For QCD the regularized formulation is manifestly Lorentz invariant, gauge invariant, ghost free and finite to all orders. A vanishing gluon mass is explicitly verified at one loop. The method is designed to respect relevant symmetries, and is expected to provide suitable regularization for any theory of interest. Hopefully, the scheme will lend itself to nonperturbative analysis. 44 refs., 16 figs.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 8716, 8727

8702 **(BNL—38766) The heavy ion program at CERN.** Lissauer, D. (Brookhaven National Lab., Upton, NY (USA); Tel Aviv Univ. (Israel)). 30 Sep 1986. Contract AC02-76CH00016. 7p. (CONF-860701—56). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002591.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

During two periods in 1986 and 1987, oxygen ion beams with energies up to 3.2 TeV will be available at the CERN-SPS. A brief review of the five large heavy ion experiments is presented and the different physics addressed by each of the experiments is discussed. 11 refs., 5 figs.

8703 **(NEANDC(E)—272-U-Vol.3) Annual progress report on nuclear data, 1985.** (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Sep 1986. 87p. (INDC(EUR)—020/6). NTIS (US Sales Only), PC A05/MF A01. File Number DE87900271.

Technical reports are presented for two broad categories of information, nuclear data and nuclear metrology. Within the nuclear data category a review of data for standards includes neutron and non-neutron data. Nuclear data for fission technology presents neutron data for the actinides and structural materials, and information related to fission technology. There are also sections on fusion technology and special studies. The nuclear metrology category includes data pertaining to radionuclides and neutron flux and dose. A technical appendix, list of publications, and CINDA entries are included. 43 figs.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 8199, 8702

8704 **(CERN-EP—86-105) Antiprotonic, hyperonic, and antihydrogen atoms.** Poth, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). 6 Aug 1986. 22p. (CONF-8604201—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900150.

From Antimatter physics at low energies; Batavia, IL, USA (10 Apr 1986).

The outcome of previous antiprotonic atom measurements is summarized. The state of the art of present experimental techniques at LEAR is described and an outlook on future experiments using the method of antiprotonic atoms is given. Intense low-energy antiproton beams might be used as a source for tagged slow hyperons. A possibility for this will be discussed and, in particular, applied to the formation of hyperonic (Σ^-, Xi^-) atoms. These systems are suitable for measuring the magnetic moment of the sigma and of the cascade particle. Moreover, this might become a competitive way to produce the H dibaryon. A cooled and stored antiproton beam of high intensity promises the best potential for forming an intense antihydrogen beam. Here we will discuss how this can be accomplished using the electron cooling technique. 43 refs., 10 figs.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

8705 **(LA-UR—86-3588) Quenching of Gamow-Teller strength.** Rapaport, J. (Los Alamos National Lab., NM (USA); Ohio Univ., Athens (USA)). 1986. Contract W-7405-ENG-36. 21p. (CONF-8610167—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001970.

From Isovector excitations in nuclei; Vancouver, Canada (7 Oct 1986).

The (p,n) reaction at intermediate energies has been used to measure differential cross sections in light nuclei, to final states

characterized with a ΔJ/sup π/ = 1⁺ transfer (GT states). Experimental ft values for allowed beta-decay transitions in these nuclei are used to normalize the strength of the GT transitions in units of B(GT). This experimental GT strength is compared with predicted shell model strength. For p-shell nuclei the calculated excitation energies of the GT strength using Cohen and Kurath wave-functions are in general agreement with the empirical GT distribution. Up to an excitation energy of about 20 MeV, the total experimental and calculated GT strengths are used to obtain the quenching factor, Q/sub F/ = ΣB(GT)/sub exp/ΣB(GT)/sub th/. It is found that Q/sub F/ decreases as the shell gets filled up. The lowest value seems to occur for single-hole nuclei. This decrease may be explained by configurations mixing not specifically included in the calculations. 21 refs., 4 figs.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

8706 **Fission-like yields in /sup 16/O+/sup 40,44/Ca reactions.** Sanders, S.J.; Betts, R.R.; Ahmad, I.; Lesko, K.T.; Saini, S.; Wilkins, B.D.; Videbaek, F.; Dichter, B.K. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 5, 1746-1756(Nov 1986). Contract W-31-109-ENG-38;AC02-76ER03074.

Inclusive cross sections for the /sup 16/O+/sup 40/Ca reaction leading to fission-like fragments with mass 20≦A/sub fragment/≦28, and for the /sup 16/O+/sup 44/Ca reaction with 20≦A/sub fragment/≦30, have been determined by measurements at seven energies with 69.3≦E/sub lab/(/sup 16/O)≦87.3 MeV and for 30°≦theta/sub lab/≦60°. The evaporation-residue cross sections were also measured over a limited angular range at the same energies to search for any gross difference between these cross sections for the two systems. No difference was detected outside the experimental uncertainties. The resulting energy spectra and mass distributions for the fission-like yields are shown to be consistent with a fusion-fission reaction mechanism. Although it was not possible to determine the total fission-like cross sections since the apparent mass range of the fission-like yields was greater than that covered by the experiment, the magnitude and energy dependence of the observed fission-like cross sections, as compared to the evaporation-residue cross sections, are also found to be consistent with a fusion-fission mechanism.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

8707 **Systematics of fragment angular distributions in high-energy proton reactions.** Wang, C.F.; Porile, N.T. (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 5, 1911-1916(Nov 1986).

Angular distributions of deep spallation and fragmentation products of the interaction of 800 GeV protons with lanthanum, terbium, and lutetium have been measured. The angular distributions can be characterized by two parameters, A_1 and A_3, which determine the asymmetry and the anisotropy, respectively. For products with Aapprox. >30, values of A_1 and A_3 derived from high-energy proton data for targets ranging from silver to uranium are found to scale with the mass difference between target and product.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

8708 **(CERN-EP—86-117) Nuclear shape transition in neutron-deficient gold isotopes.** Wallmeroth, K.; Bollen, G.; Borge, M.J.G.; Campos, J.; Dohn, A.; Egelhof, P.; Gruener, J.; Kluge, H.J.; Kroenert, U.; Lindenlauf, F. (European Organization for Nuclear Research, Geneva (Switzerland); Mainz Univ. (Germany, F.R.); Universidad Complutense, Madrid (Spain); McGill Univ., Montreal, Quebec (Canada); Georgia Inst. of Tech., Atlanta (USA); Bhabha Atomic Research Centre, Bombay (India)). 3 Sep 1986. 5p. (CONF-860918—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900149.

From 7. international conference on hyperfine interactions; Bangalore, India (8 Sep 1986).

On-line resonance ionization mass spectrometry has been applied to determine the isotope shift and hyperfine structure of /sup 185-189/Au and the I = 9/2 isomer of ^{189}Au in the 6s ^{2}S/sub 1/2/ → 6p ^{2}P/sub 1/2/ (λ = 268 nm) transition. The Au atoms were obtained as daughters of mass-separated Hg isotopes produced at the ISOLDE facility at CERN, ionized by a three-step resonant photoionization process, detected and mass-selected by time of flight. A drastic change of the nuclear charge radious was observed between ^{187}Au and ^{186}Au, which is interpreted as an onset of strong deformation of $\beta_2 \simeq 0.25$ in ^{186}Au and ^{185}Au. 12 refs., 4 figs.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

8709 **(ANL/NDM—96) Nuclear data and measurements series: Ratio of the prompt-fission-neutron spectrum of plutonium 239 to that of uranium 235.** Sugimoto, M.; Smith, A.B.; Guenther, P.T. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002518.

The prompt-fission-neutron spectrum resulting from ^{239}Pu fission induced by 0.55 MeV incident neutrons is measured from 1.0 to 10.0 MeV relative to that of ^{235}U fission induced by the same incident-energy neutrons. The measurements employ the time-of-flight technique. Energy-dependent ratios of the two spectra are deduced from the measured values over the energy range 1.0 to 10.0 MeV. The experimentally-derived ratio results are compared with those calculated from ENDF/B-V, revision-2, and with results of recent microscopic measurements. Using the ENDF/B-V ^{235}U Watt parameters for the ^{235}U spectrum, the experimental measurements imply a ratio of average fission-spectrum energies of ^{239}Pu/^{235}U = 1.045 +- 0.003, compared to the value 1.046 calculated from ENDF/B-V, revision 2. 12 refs., 2 figs., 2 tabs.

6530 Nuclear Theory

8710 **(LBL—21765) Dependence of heavy-ion neutron transfer on distance and spin.** Rasmussen, J.O.; Stoyer, M.A.; Guidry, M.W.; Canto, L.F.; Donangelo, R. (Lawrence Berkeley Lab., CA (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA); Rio de Janeiro Univ. (Brazil). Inst. de Fisica). Jun 1986. Contract AC03-76SF00098. 17p. (CONF-8606130—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002573.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

We review the "slope anomaly" data for 2-neutron transfer between heavy ions. Where one or both partners are deformed, the 2-neutron transfer always shows about the same dependence on distance-of-closest approach D as does 1-neutron transfer. Where both partners are spherical, the 2-neutron transfer falls off as the square of the 1-n transfer with one known exception ^{208}Pb(^{64}Ni,^{62}Ni)^{210}Pb. We propose that the enhancement of 2-n transfer comes from the pairing attraction between the neutrons and that the enhancement requires availability of high-l orbitals to form a tight wave packet in angle. A simple model is derived for numerical esti-

mation. Prospects for testing Coriolis antipairing by heavy ion 2-n transfer are re-examined. 10 refs., 3 figs.

8711 **(UCRL—15847-Vol.4) Pairing in nuclei.** Moeller, P.; Madland, D.G.; Nix, J.R. (Lawrence Livermore National Lab., CA (USA); Los Alamos National Lab., NM (USA)). Sep 1986. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002502.

New expressions for the nuclear neutron and proton average pairing gaps have been derived. In addition, a new expression for the average residual n-p interaction energy appearing in the masses of odd-odd nuclei has been introduced. For protons the new model for the average pairing gap agrees better with the data than the old model. For neutrons there is no major difference between the models for the average pairing gap, but far from stability there would be larger differences. 3 refs., 6 figs. (DWL)

8712 **(UCRL—95397) Single particle effects in precompound decay reactions.** Blann, M.; Komoto, T.; Reffo, G.; Fabbri, F.; Grimes, S.M. (Lawrence Livermore National Lab., CA (USA); ENEA, Bologna (Italy); Ohio Univ., Athens (USA). Dept. of Physics). Sep 1986. Contract W-7405-ENG-48. 25p. (CONF-8610164—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000601.

From International Atomic Energy Agency conference; Bologna, Italy (6 Oct 1986).

Precompound decay models generally rely on use of a partial state density (PSD) formula which is generated using an assumed equidistantly spaced set of single particle levels. This is a reasonable assumption for mid-shell nuclei; however it has been demonstrated that quite large errors may be introduced by making the equidistant spacing assumption for nuclei which have neutron or proton numbers near or at major shell closures. This work reviews the simple qualitative considerations of those deviations expected for near closed shell nuclei, these expectations are compared with experimental results, and steps are taken to implement use of partial state densities calculated with more realistic sets of single particle levels in precompound decay calculations. This is done for the case of Zr targets. 13 refs., 14 figs.

8713 **An SO/sub 8/ model of collectivity in nuclei.** Ginocchio, J.N. (Theoretical Div., Los Alamos National Lab., Univ. of California, Los Alamos, NM). pp 81-95 of Proceedings of the workshop on bosons in nuclei. Feng, D.H.; Vallieres, M.; Pittel, S. Singapore; World Scientific Pub. Co. Pte. Ltd. (1984).

In this review the authors show how it is possible to have fermion Hamiltonians which have a class of collective eigenstates composed entirely of monopole and quadrupole pairs of fermions. Hence these models satisfy the assumptions 1) and 2) above but no boson approximation need be made thus the Pauli principle is kept intact.

8714 **Aspects of the finite boson number in the IBA.** Warner, D.D. (Brookhaven National Lab., Upton, NY). pp 133-154 of Proceedings of the workshop on bosons in nuclei. Feng, D.H.; Vallieres, M.; Pittel, S. Singapore; World Scientific Pub. Co. Pte. Ltd. (1984).

One of the most important and distinguishing features of the IBA description of nuclear structure is the explicit inclusion of the finite number of valence nucleon in its basis, via the boson number N. To date, attempts to study the effects of the finite boson number on IBA predictions, and to verify those predictions empirically, have concentrated on high spin states, where the predicted cut off in angular momentum at L=2N, inherent in the simple s-d basis, manifests itself in terms of a "rolling over" of the B(E2) values within the ground state rotational band. The present discussion is aimed at exploring the role played by the finite boson number in the properties of low lying, low spin states across a broad range of nuclei. In such cases, any agreement or discrepancy cannot, in general, be attributed to neglected degrees of freedom, and thus reflects on the validity of the boson number assumption itself, which in turn represents a crucial element in the microscopic link with the underlying shell model basis.

8715 **Combined analysis of inelastic electron-scattering and muonic-atom hyperfine-splitting data: an application to ^{152}Sm.** Reuter, W.; Shera, E.B; Wohlfahrt, H.D. (Los Alamos National Lab., NM). *Physics Letters [Section] B;* **124B**: No. 5, 293-296(5 May 1983).

The authors explore a method for combined analysis of inelastic electron-scattering data and muonic quadrupole hyperfine-splitting measurements. The method, applied here to ^{152}Sm, provides an accurate normalization for (e,e') data, a precise value for $B(E2;0^+ \rightarrow 2^+)$, and shows that the interpretation of the monopole (elastic) and quadrupole (inelastic) data from both experiments is consistent at the present level of experimental accuracy. 14 references, 7 figures.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 8623

8716 **(NP—7900274) Poisoning effects in spallation neutron sources.** Atchison, F. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). [1986]. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900274.

The practical design for a continuous spallation neutron source needs to take proper note of neutron economy. The critical region in and around the moderator should avoid the use of materials with a high thermal neutron capture cross-section. During operation, high-energy nucleon induced spallation reactions lead to production of nuclides which have a large thermal capture cross-section. Rather small quantities of material with cross-sections in the kilo-barn range will lead to significant increase of absorption. The build-up rates of absorption in lead-bismuth, heavy water, aluminum, carbon, iron, and steel have been estimated and are presented in this report. 2 refs., 4 tabs., 3 figs.

8717 **(WAPD-T—2889) PACER-IBM: A two dimensional Monte Carlo multigroup program for the IBM personal computer.** Martz, R.L.; Candelore, N.R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Nov 1986. Contract AC11-76PN00014. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002703.

PACER-IBM is a Monte Carlo computer program written in BASIC at Bettis for the IBM personal computer. This program is capable of solving simple two dimensional neutron transport problems in X - Y geometry. The space - energy neutron flux distribution over the energy range of 10 MeV to 0 eV is calculated using fixed source starts within the source regions of the solution geometry. PACER-IBM accesses multigroup cross sections which have been prepared using the CDC-7600 program RCPL1, a program to prepare neutron and photon cross section libraries for RCP01, and down loaded from the CDC-7600. Neutron behavior in the PC program is simulated by a random walk, a process that is identical to that used in the CDC-7600 Monte Carlo program PACER. A neutron's location in phase space, i.e.., its position, direction, and energy is selected randomly and the neutron is tracked through the solution geometry (in free flight) until a collision occurs. In the collision analysis new neutron direction and energy are selected randomly based upon probabilities determined from basic neutron cross section data. The tracking process and the collision analysis is continued until a termination event, such as absorption, leakage, or slowing down below a specified energy, occurs. The set of calculations for one neutron from source to termination is called a neutron history. A large number of histories is processed to estimate the space-energy neutron flux. Comparisons of results with CDC-7600 PACER solutions are favorable for several two dimensional test problems. 2 refs.

8718 **(WINCO—1010) QAD-FN: A general-purpose shielding design code with simplified input.** Nielsen, C.W.; Hochhalter, E.E. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Oct 1986. Contract AC07-84ID12435. 59p. NTIS, PC E04/MF A01; 1; GPO Dep. File Number DE87002852.

This is a users manual for the point kernal gamma shielding code QAD-FN and provides the user with the code description,

input parameters, a sample problem, sample problem output, error messages, and a microfiche copy of the code listing. QAD-FN was modified to simplify the input data by adding the FASTER geometry package and internal data libraries for the polynomial buildup coefficients and mass attenuation coefficients for gamma energies between 0.05 and 10.0 MeV. The gamma flux-to-dose conversion factors are calculated internally by QAD-FN using the ANSI/ANS 6.6-1 - 1977 equations. The neutron calculation portion of QAD-FN does work, but its use is not recommended. 9 refs., 10 figs.

8719 **Monte Carlo and discrete ordinates calculations for 14 MeV neutrons streaming through a stainless steel duct: Comparisons with experiment.** Santoro, R.T.; Barnes, J.M.; Alsmiller, R.G. Jr.; Drischler, J.D. (Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **250**: No. 3, 557-564(20 Sep 1986). Contract AC05-84OR21400.

Measured and calculated neutron energy spectra from 14 MeV neutrons streaming through stainless steel ducts having length-to-diameter ratios of 14.8 and 38.2 are compared in this paper. The measured data were obtained using an NE213 liquid scintillator and the calculated data were obtained using the Monte Carlo code MCNP and the discrete ordinates code DOT 4.3. For both duct geometries, the spectra calculated using the MCNP code are in reasonable agreement with the measured data ranging from a few percent to a factor of 2, depending on the detector location and duct. The spectra calculated using the DOT code are in fair agreement (30%) for cases where the detector is on the duct axis, but are in poor agreement, up to an order of magnitude, when the detector is off axis.

8720 **Electron backscattering from a silicon detector from 0.182 to 0.579 MeV.** Carrington, A.; Nicholson, H.W.; Krivicich, J. (Mount Holyoke Coll., South Hadley, MA, USA; Lawrence Berkeley Lab., CA, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **248**: No. 2/3, 425-428(1 Aug 1986). Contract AC02-78ER04831;W-7405-ENG-48.

The fraction of electrons normally incident on a silicon surface barrier detector giving up less than their total energy in the detector due to backscattering has been measured in a good geometry experiment for eight incident electron energies between 0.182 and 0.579 MeV. The backscattering fraction is constant within errors over this energy range and has an approximate value of 0.134.

6550 Medical Physics

REFER ALSO TO CITATION(S) 8538

8721 **(BLG—575) Standardization of radionuclides at the SCK/CEN.** Ballaux, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Feb 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900238.

This status report summarizes the techniques applied and the results achieved, between 1973 and 1983, in the laboratory for radionuclide metrology of SCK/CEN. The techniques for the quantitative and qualitative preparation of radioactive sources are briefly described and a few details are given concerning $4\pi\beta$ and $2\pi\alpha$ proportional counting, 4π (PC)-γ coincidence counting with efficiency extrapolation and measurements with well-type NaI(Tl) detectors. From several intercomparisons it appears that accuracies were achieved, comparable to those from important national and international standardizing laboratories. During this period the annual production was about 100 standards of about 20 different radionuclides. 25 refs., 5 tabs.

8722 **(ORNL/TM—10168) An algorithm for unfolding neutron dose and dose equivalent from digitized recoil-particle tracks.** Bolch, W.E.; Turner, J.E.; Hamm, R.N. (Oak Ridge National Lab., TN (USA); Florida Univ., Gainesville (USA). Dept. of Environmental Engineering Sciences). Oct 1986. Contract AC05-84OR21400. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002074.

Previous work had demonstrated the feasibility of a digital approach to neutron dosimetry. A Monte Carlo simulation code of one detector design utilizing the operating principles of time-projection chambers was completed. This thesis presents and verifies one version of the dosimeter's computer algorithm. This algorithm processes the output of the ORNL simulation code, but is applicable to all detectors capable of digitizing recoil-particle tracks. Key features include direct measurement of track lengths and identification of particle type for each registered event. The resulting dosimeter should allow more accurate determinations of neutron dose and dose equivalent compared with conventional dosimeters, which cannot measure these quantities directly. Verification of the algorithm was accomplished by running a variety of recoil particles through the simulated detector volume and comparing the resulting absorbed dose and dose equivalent to those unfolded by the algorithm.

8723 **(UCRL—95494) External monitoring in the next ten years.** Griffith, R.V. (Lawrence Livermore National Lab., CA (USA)). 15 Oct 1986. Contract W-7405-ENG-48. 43p. (CONF-861044—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002384.

From Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

Predictions are made for the requirements for external dosimetry through the 1990's. Photon, neutron, and beta dosimetry are discussed. Identified needs include: (1) improved dosimeter accuracy; (2) improved dosimeter sensitivity; (3) capability to obtain information about radiation field characteristics, particularly energy spectra, both from dosimeters and survey instruments; (4) improved survey and dosimetry record keeping systems; and (5) improved techniques for estimating organ doses. (ACR)

6561 Superconductivity

REFER ALSO TO CITATION(S) 8347

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 8414

8724 **(DEMO—84/14) Estimation of magnetic field in a region from measurements of the field at discrete points.** Alexopoulos, T.; Dris, M.; Lucas, D. (Democritos Nuclear Research Center, Athens (Greece)). Dec 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900236.

A method is given to estimate the magnetic field in a region, from measurements of the field in its surface and its interior. The method might be useful for High Energy Physics and other experiments that use large area magnets. 5 refs., 10 figs.

8725 **(DOE/ER/13147—2-Pt.6) Comparison of algorithms for determining Lyapunov exponents from experimental data.** Vastano, J.A.; Kostelich, E.J. (Texas Univ., Austin (USA)). 1985. Contract AS05-84ER13147. 8p. (CONF-8509203—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000762.

From International conference on dimensions and entropies in chaotic systems; Pecos River, NM, USA (11 Sep 1985).

Two methods for estimating the Lyapunov exponents of attractors reconstructed from a time series are compared. A method due to Wolf et al. for computing the largest Lyapunov exponent λ_1 is found to be robust with reasonable changes in input parameters. In contrast, a least-squares method suggested by Eckmann and ruelle yields estimates for the Lyapunov exponents that vary considerably depending on the embedding dimension of the attractor. It appears that only the Wolf algorithm is suitable for the analysis of experimental data. 8 refs., 5 figs., 1 tab.

8726 **(DOE/ER/13147—2-Pt.8) Intermediate length scale effects in Lyapunov exponent estimation.** Wolf, A.; Vastano, J.A. (Cooper Union, New York (USA). School of Engineering; Texas Univ., Austin (USA)). 1985. Contract AS05-84ER13147. 6p. (CONF-8509203—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000764.

From International conference on dimensions and entropies in chaotic systems; Pecos River, NM, USA (11 Sep 1985).

Algorithms for estimating Lyapunov exponents from experimental data monitor the divergence of nearby phase space orbits. These algorithms rely on the assumption that the dynamics on intermediate length scales are "close" to the dynamics on infinitesimal length scales. We have studied two one-dimensional maps in which intermediate length scale dynamics may result in inaccurate exponent estimates. This effect is found to be small enough so that the exponent estimates are still good characterizations of the systems. Similar effects are likely to be present whenever a finite quantity of data is used for Lyapunov exponent estimation. 12 refs., 4 figs.

8727 **(INIS-mf—10512) Annual convention 1986 of the Austrian Physical Society.** (Oesterreichische Physikalische Gesellschaft, Vienna). 1986. 109p. (In German and English). (CONF-8609176—). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700241.

From Austrian Physical Society annual convention; Innsbruck, Austria (22 Sep 1986).

There are 152 contributions, 58 thereof of INIS interest. The subject matters are indicated by the grouping of contributions into topical sessions on 1) nuclear and particle physics 2) physics of high polymers 3) atomic and plasma physics. There is additionally a session for teachers continuation training and one page information on the Austrian Physical Society.

8728 **(LBL—21472-Rev.) Variational formulation of covariant eikonal theory for vector waves.** Kaufman, A.N.; Ye, H.; Hui, Y. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 14p. (CONF-8605122—1-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002570.

From 4. symposium on energy engineering sciences: chemical processes and control - non-linear systems; Argonne, IL, USA (7 May 1986).

The eikonal theory of wave propagation is developed by means of a Lorentz-covariant variational principle, involving functions defined on the natural eight-dimensional phase space of rays. The wave field is a four-vector representing the electromagnetic potential, while the medium is represented by an anisotropic, dispersive nonuniform dielectric tensor D/sup $\mu\nu$/(k,x). The eikonal expansion yields, to lowest order, the Hamiltonian ray equations, which define the Lagrangian manifold k(x), and the wave-action conservation law, which determines the wave-amplitude transport along the rays. The first-order contribution to the variational principle yields a concise expression for the transport of the polarization phase. The symmetry between k-space and x-space allows for a simple implementation of the Maslov transform, which avoids the difficulties of caustic singularities.

70 FUSION ENERGY

7001 Plasma Research

8729 **(CONF-851102—114) Updated tokamak systems code and applications to high-field ignition devices.** Reid, R.L.; Galambos, J.D.; Peng, Y-K.M.; Strickler, D.J.; Selcow, E.C. (Oak Ridge National Lab., TN (USA); Grumman Aerospace Corp., Bethpage, NY (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002188.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

This paper describes revisions made to the Tokamak Systems Code to more accurately model high-field copper ignition devices. The major areas of revision were in the plasma physics model, the toroidal field (TF) coil model, and the poloidal field (PF) coil/MHD model. Also included in this paper are results obtained from applying the revised code to a study for a high-field copper ignition device to determine the impact of magnetic field on axis, (at the major radius), on performance, and on cost.

8730 **(CONF-861110—1) Feasibility study of an infrared system for the plasma diagnostics on the compact ignition tokamak.** Ma, C.H.; Hutchinson, D.P. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002201.

From American Physical Society Plasma Physics Division meeting; Baltimore, MD, USA (3 Nov 1986).

The preliminary results of a feasibility study of a two-dimensional infrared system for plasma diagnostics on the Compact Ignition Tokamak (CIT) are presented. The proposed system will provide simultaneous measurements of electron density (interferometer), plasma current (Faraday rotation, polarimeter), and density fluctuation (small-angle scattering). A preliminary design of the system is shown.

8731 **(DOE/ER/53223—16) Supplementary reports to the code 3D-ETC.** Dinkevich, S.; Bayliss, A. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Jul 1986. Contract FG02-86ER53223. 46p. (MF—110). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002519.

The following three sections are included: (1) implicit scheme for plasma transport in three dimensions, (2) the ODE which accompanies a set of plasma transport equations, and (3) anisotropic plasma transport in three dimensions: flow charts of the code. (MOW)

8732 **(DOE/ER/53223—18) Extending the semi-implicit MHD method: Grid-point models and improved accuracy.** Harned, D.S. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Sep 1986. Contract FG02-86ER53223. 12p. (MF—112). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002520.

The semi-implicit method for the MHD equations is extended to grid-point models and for implementation with a more accurate time advance scheme.

8733 **(DOE/ET/51013—197) Extraordinary mode absorption at the electron cyclotron harmonic frequencies as a Tokamak plasma diagnostic.** Pachtman, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1986. Contract AC02-78ET51013. 194p. (PFC/RR—86-22). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87002772.

Measurements of Extraordinary mode absorption at the electron cyclotron harmonic frequencies are of unique value in high temperature, high density Tokamak plasma diagnostic applications. An experimental study of Extraordinary mode absorption at the semi-opaque second and third harmonics has been performed on the ALCATOR C Tokamak. A narrow beam of submillimeter laser radiation was used to illuminate the plasma in a horizontal plane, providing a continuous measurement of the one-pass, quasi-perpendicular transmission.

8734 **(DOE/ET/51013—198) Electron microinstabilities in an ECRH, mirror-confined plasma.** Garner, R.C. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1986. Contract AC02-78ET51013. 202p. (PFC/RR—86-23). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87002723.

The ECRH, mirror-confined plasma of the Constance B experiment is whistler unstable. Two types of rf emission, referred to as whistler B (bursting) and whistler C (continuous), are observed. The whistler B emission bursts at a fairly regular rate and correlates with electron and ion endless bursts and diamagnetism and potential fluctuations. The burst rate increases for increasing electron heating rate. The whistler C emission comes continuously in time and is associated with continuous enhanced endloss. The whistler C emission is associated with off-axis plasma where the heating rate is expected to be higher than on-axis due to low field line gradients at

resonance. The Constance B plasma is characterized by three electron components: cold (100 eV), warm (2 keV), and hot (400 keV). The whistler instability is studied over a wide range of machine operating conditions to determine (1) its effect on the electron velocity space distribution function and (2) the enhanced particle and power loss it induces. Power loss due to microinstability is primarily in the form of unstable rf emission (40 W) and induced warm and hot electron endloss (80 W and 90 W, respectively). These numbers correspond to an ECRH input power of 1000 W. Relativistic Vlasov dispersion relation calculations with a new distribution function (ECRH distribution) are performed. The ECRH distribution function models a population of ECRH, mirror-confined electrons. Theoretically calculated unstable whistler frequencies match the experimentally measured frequencies when the ECRH distribution is used to model the warm electrons.

8735 **(DOE/ET/53088—252) Papers presented by IFS (Institute for Fusion Studies)/FRC (Fusion Research Center) members at the international workshop on small scale turbulence and anomalous transport in magnetized plasmas.** Scott, B.D.; Bengtson, R.D.; Diamond, P.H.; Terry, P.W. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Sep 1986. Contract FG05-80ET53088. 30p. (IFSR—252). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002036.

Abstracts were prepared for each of the four included papers. (MOW)

8736 (DOE/ET/53088—252, pp 20-24) **Ion pressure gradient driven turbulence: theory and consequences.** Diamond, P.H.; Lee, G.S.; Mattor, N.; Katt, P.T. (Univ. of Texas, Austin). Sep 1986. NTIS, PC A03/MF A01. File Number DE87002036. (IFSR—252).

In Papers presented by IFS (Institute for Fusion Studies)/FRC (Fusion Research Center) members at the international workshop on small scale turbulence and anomalous transport in magnetized plasmas.

Ion pressure gradient driven turbulence (IPGDT) due to eta/sub i/-modes is of interest both as a paradigm for saturated, multifield turbulence and as an agent for anomalous transport in fusion devices. The results of recent investigations of IPGDT are summarized. Special emphases are placed on the validity of "mixing length rules" and on the relation of ion thermal transport to particle confinement. The possible role of IPGDT in RFP plasmas is discussed.

8737 (DOE/ET/53088—252, pp 25-28) **Localized fluctuations in inhomogeneous plasma turbulence; structure, dynamics, relaxation, and transport.** Terry, P.W.; Diamond, P.H.; Hahm, T.S. (Univ. of Texas, Austin). Sep 1986. NTIS, PC A03/MF A01. File Number DE87002036. (IFSR—252).

In Papers presented by IFS (Institute for Fusion Studies)/FRC (Fusion Research Center) members at the international workshop on small scale turbulence and anomalous transport in magnetized plasmas.

Localized fluctuations which are either decaying of self-binding are an important component of plasma turbulence often neglected in conventional treatments. Both types of localized fluctuations are described in the context of 3-D drift kinetic systems. Their role in plasma stability and transport is emphasized.

8738 **(LRP—219/83) Plasma equilibrium in the TCA tokamak.** Hofmann, F.; Joye, B. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Mar 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900219.

Plasma equilibria in the TCA tokamak have been computed using the 2D numerical code FBT. The effects of current peaking, density peaking and poloidal beta have been investigated. The results are compared with measurements on TCA.

8739 **(LRP—227/83) Quasilinear theory of uniformly magnetized inhomogeneous plasmas: Electromagnetic fluctuations.** Yasseen, F.; Vaclavik, J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Feb 1985. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900190.

The equations of quasilinear theory are derived for a uniformly magnetized inhomogeneous plasma interacting with electromagnetic field fluctuations. The derivation avoids the use of the random phase approximation. The equations are formulated in a way that allows the identification of corrections arising from a finite Larmor radius to inhomogeneity scale ratio. These equations possess the necessary local conservation properties, and require no assumption on the ratio of the Larmor radius to the fluctuation wavelength.

8740 **(LRP—233/84) Computation of symmetric ideal MHD flow equilibria.** Semenzato, S.; Gruber, R.; Zehrfeld, H.P. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). May 1984. 65p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87900195.

The symmetric ideal magnetohydrodynamic equilibrium equations with flow lead to a nonlinear system of four algebraic equations and one quasilinear partial differential equation. These equations are solved numerically by a continuation method, by a Picard iteration and a finite element approach. The nodal points are redistributed iteratively such that they fall on initially prescribed constant flux surfaces. Different coordinate systems are introduced and applied to a static case. A first application to JET is made.

8741 **(LRP—234/84) On the generation of superthermal electrons in lower-hybrid current-drive experiments.** Succi, S.; Appert, K.; Muschietti, L.; Vaclavik, J.; Wersinger, J.M. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Feb 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900196.

It is shown that a small, low-phase-velocity part of a power source spectrum can strongly enhance the amount of the current generated in lower-hybrid current-drive experiments. A good agreement between the calculated and observed current is found.

8742 **(LRP—235/84) MHD equilibrium calculations of highly-elongated racetracks in a tokamak.** Hofmann, F.; Marcus, F.B. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Jun 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900177.

Calculational methods and results are presented for racetrack-shaped, highly-elongated plasmas in a tokamak. Such equilibria may have high critical β and long confinement times, even at the large aspect ratios ~ 4 required for reactors such as INTOR, if scaling laws determined at elongations $K \leqq 1.8$ extrapolate to higher K. The MHD equilibria are calculated with a free boundary code which requires shaping coil currents as input. To estimate these currents, the shape of the outermost flux surface is specified in a separate computation to be a $K = 4/1$ racetrack, and a guess at the final plasma current profile is added. A matrix equation relating uniformly-spaced phi values on the desired flux surface to the shaping currents plus plasma current is inverted to obtain the shaping currents.

8743 **(LRP—239/84) A semi-empirical scaling law for the beta-limit in tokamak.** Troyon, F.; Gruber, R. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Jan 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900200.

A limited numerical optimization of the current and pressure profiles in Tokamaks of various shapes and aspect ratios has led to a simple scaling law for the maximum volume averaged β which can be reached before the onset of ideal MHD instabilities: $\beta < 2.0$ to $2.5\mu_0 I/Ba$, where I is the total current, B the toroidal field at the centre of the plasma and a the minor plasma radius in the equatorial plane. The limit is set by the appearance of a $n = 1$ free boundary instability, neglecting the possible stabilizing effect of a shell. The highest βs attained in tokamaks equipped with strong auxiliary heating are shown to be very near the limit given by this scaling law in spite of their very different conditions of operation. Possible implications are discussed.

8744 **(LRP—241/84) Target plasma conditions in TCA.** de Chambrier, A.; Collins, G.A.; Hollenstein, C.; Joye, B.; Lister, J.B.; Moret, J.M.; Nowak, S. Pochelon, A.; Simm, W. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Nov 1984. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87900180.

We discuss the conditions of the target plasma in the TCA tokamak prior to the rf heating pulse. The toroidal field and plasma current are held fixed and the density is varied from anti n/sub e/ $\sim 0.5 \times 10^{13}$ to 5×10^{13} cm^{-3}. Both hydrogen and deuterium discharges are considered. The density and gas dependence of the macroscopic plasma parameters is analyzed, as well as the impurity and energy content. We observe an increasing peaking of the electron density profile as the density is increased. This observation is compatible with other small tokamaks and we present a density profile scaling law that depends on the Murakami parameter n/sub e/(0)R_0/B/sub phi/. We find that for this range of density, the global energy confinement time is proportional to the line density as is typically the case before the saturation of "Alcator Scaling" which provides an adequate representation of the data. We perform a radial electron power balance in order to estimate the electron thermal conductivity n/sub e/chi/sub e/. Its value at half radius is around 4×10^{17} $cm^{-1}s^{-1}$ for the lowest density discharges and decreasing to 2×10^{17} $cm^{-1}s^{-1}$ at the highest density. The diagnostics used for this study are also briefly described, together with their analysis techniques.

8745 **(LRP—245/84) The ponderomotive force of an electromagnetic wave in a multi-ion species plasma.** Festeau-Barrioz, M.C.; Sawley, M.L. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Aug 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900194.

The ponderomotive force exerted by a standing electromagnetic wave in an infinite, magnetized plasma containing two ion species is examined. A perturbation analysis is developed to solve the nonlinear wave equation subject to the constraint that the total number of particles of each species is conserved. Detailed calculations are presented for an ion cyclotron wave, for which large modifications of the ion densities result from the influence of the ponderomotive force. To determine the range of validity of the perturbation analysis, the results are compared with those obtained by numerical integration of the nonlinear wave equation.

8746 **(LRP—248/84) Experimental study of low frequency surface waves in a resistive plasma column.** Sawley, M.L. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Aug 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900178.

Low frequency ($\omega << \omega$/sub ci/), non-axisymmetric (m = +-1) surface waves have been observed in a low temperature hydrogen plasma. Good agreement is found between the values of Re(k/sub parallel/) measured in the experiment and those calculated using a theory describing wave propagation in a uniform, resistive plasma column. However, the waves are observed to be much more strongly damped than is predicted from this theory. A possible explanation is that the presence of density and temperature gradients leads to enhanced damping due either to the larger resistivity in the vicinity of the plasma boundary, or to the effect of the spatial Alfven resonance. A simple non-uniform plasma theory shows that, even for the low temperature plasma considered, the wave damping due to the spatial Alfven resonance should be much greater than that calculated from the uniform plasma theory. A much closer agreement is obtained by comparing the experimental values of wave damping with those calculated from the non-uniform theory.

8747 **(LRP—249/84) Buffer gases to increase the efficiency of an optically pumped far infrared D_2O laser.** Behn, R.; Dupertuis, M.A.; Kjelberg, I.; Krug, P.A.; Salito, S.A.; Siegrist, M.R. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Mar 1985. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900179.

The effects of buffer gas additives on the performance of an optically pumped D_2O laser operating at 385 μm have been investigated both experimentally and by numerical simulation. Three gases, sulphur hexafluoride, carbon tetrafluoride and n-hexane were found to produce an increase of up to 40% in the pumping efficiency, as well as significant lengthening of the far infrared pulse. Under optimum conditions 2.6 J in a 1 μs long pulse have been obtained. The buffer gases are shown to eliminate the vibrational deexcitation bottleneck, which in pure D_2O leads to an accumulation of population in the upper vibrational level, and hence a reduction in the efficiency of absorption of the pump beam. Comparison of the observed buffer gas effects with the predictions of a numerical simulation code based on a rate equation model gives information about the constants for vibrational and rotational relaxation rates due to D_2O-D_2O and D_2O-buffer gas collisions.

8748 **(LRP—254/85) Generation of superthermal electrons interacting with lower hybrid waves revisited.** Succi, S.; Appert, K.; Vaclavik, J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Jan 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900184.

The problem of quasilinear diffusion of plasma electrons, resonantly interacting with lower-hybrid waves launched from the exterior, is examined within a self-consistent one-dimensional homogeneous model. An analytical solution is obtained, which allows the derivation of a simple formula for the plasma current in terms of the parameters characterizing the spectral distribution of the rf power source. The major outcome is a dramatic sensitivity of the plasma current to the presence of a small, high-N/sub parallel/ component in the rf power source spectral distribution, in agreement with previous numerical calculations.

8749 **(LRP—257/85) The phase contrast technique as an imaging diagnostic for plasma density fluctuations.** Weisen, H. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Jan 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900182.

The phase contrast technique offers an attractive alternative to small angle Thomson scattering for the investigation of plasma density fluctuations. This imaging technique converts small relative phase shifts into detectable intensity variations. A wave optics treatment is given and test results of a system built for the TCA tokamak are presented. The device is suitable for the study of density fluctuations in the wavelength range from 2 to 200 mm. It uses a low power continuous CO_2 laser probe beam of 15 cm width and liquid nitrogen cooled HgCdTe detectors. For a 1 MHz bandwidth it allows detection of phase shifts as low as 3×10^{-6} radians at the shot noise limit, corresponding to relative density variations Δn/sub e/n/sub e/ $\simeq 10^{-4}$ for typical conditions on TCA.

8750 **(LRP—259/85) Dielectric tensor operator of a nonuniformly magnetized inhomogeneous plasma.** Martin, T.; Vaclavik, J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Feb 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900181.

Differential equations for small amplitude electromagnetic perturbations in a hot nonuniformly magnetized inhomogenous plasma are derived from the Vlasov and Maxwell equations. Assuming a slab geometry, a perturbation expansion to second order in the smallness of the Larmor radius compared to characteristic scale-lengths of the plasma and fields is used. The results are expressed in terms of an equivalent dielectric tensor operator. The equations are shown to possess appropriate conservation properties.

8751 **(ORNL/TM—9602) Monte Carlo neutral density calculations for ELMO Bumpy Torus.** Davis, W.A.; Colchin, R.J. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002983.

The steady-state nature of the ELMO Bumpy Torus (EBT) plasma implies that the neutral density at any point inside the plasma volume will determine the local particle confinement time. This paper describes a Monte Carlo calculation of three-dimensional atomic and molecular neutral density profiles in EBT. The calculation has been done using various models for neutral source points, for launching schemes, for plasma profiles, and for plasma densities and temperatures. Calculated results are compared with experimen-

tal observations - principally spectroscopic measurements - both for guidance in normalization and for overall consistency checks. Implications of the predicted neutral profiles for the fast-ion-decay measurement of neutral densities are also addressed.

8752 **(ORNL/TM—10199) Measurement of the hydrogen recombination coefficient in the TEXT tokamak as a function of outgassing and power radiated during tokamak discharges.** Langley, R.A.; Rowan, W.L.; Bravenec, R.V.; Nelin, K. (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002990.

The global recombination rate coefficient k/sub r/ for hydrogen has been measured in the TEXT tokamak vacuum vessel for various surface conditions. An attempt was made to correlate the measured values of k/sub r/ with residual gas analyzer (RGA) data taken before each measurement of k/sub r/ and with the power radiated during tokamak discharges produced after each measurement of k/sub r/. The results show that k/sub r/ increases during a series of tokamak discharges, k/sub r/ is relatively insensitive to power radiated during tokamak discharges, and k/sub r/ increases with the RGA measurements of mass 28 and 40 but not with those of mass 18. In addition, it was found that the mass 18 (H_2O) signal decreases as glow discharge experiments with hydrogen were performed.

8753 **Energetic ion diagnostics using neutron flux measurements during pellet injection.** Heidbrink, W.W. (Princeton Univ., NJ, USA. Plasma Physics Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **248**: No. 2/3, 491-498(1 Aug 1986).

Also published as report PPPL–2299.

Neutron measurements during injection of deuterium pellets into deuterium plasmas on the tokamak fusion test reactor (TFTR) indicate that the fractional increase in neutron emission about 0.5 ms after pellet injection is proportional to the fraction of beam-plasma reaction to total fusion reactions in the unperturbed plasma. These observations suggest three diagnostic applications of neutron measurements during pellet injection: (1) measurement of the beam-plasma reaction rate in deuterium plasmas for use in determining the fusion Q in an equivalent deuterium-tritium plasma, (2) measurement of the radial profile of energetic beam ions by varying the pellet size and velocity, and (3) measurement of the "temperature" of ions accelerated during wave heating.

8754 **Influence of the spatial harmonics on the rotating magnetic field current drive.** Hugrass, W.N. (Los Alamos National Lab., NM, USA). *Australian Journal of Physics;* **39**: No. 4, 513-527(17 Jun 1986).

In rotating magnetic field (RMF) current drive experiments, the RMF is usually generated by means of a two-phase radio frequency system which feeds a pair of orthogonal coils. The magnetic field generated in this manner consists of the desired RMF as well as the (undesired) odd spatial harmonics. In order to evaluate the effect of these spatial harmonics on the performance of the RMF current drive experiments, we have developed a simplified theoretical model for the plasma. In this model the ions are assumed immobile and the motion of the electron fluid in the azimuthal direction is assumed to be a rigid rotation. It has been found using this model that the presence of the spatial harmonics makes the RMF current drive less efficient. It has also been found that the effect of the spatial harmonics can be made negligible by (a) making the width of the coils sufficiently larger than the diameter of the plasma, (b) carefully designing the coil configuration to eliminate the fifth harmonic or (c) using a three-phase system to generate the RMF.

8755 **Fast wave current drive.** Goree, J. (Univ. of Iowa). pp 91 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Toroidal current generation by the fast Alfven wave in the range of high ion-cyclotron harmonics (ω/Ω/sub i/ = 0(10) was recently demonstrated in the ACT-1 toroidal device. This fast wave may be more attractive for tokamak current drive than the usual lower-hybrid wave for several reasons: lower hybrid current drive (LHCD) has a density limit and fast wave current drive (FWCD) does not, and the lower-hybrid wave is scattered by density fluctuations at the plasma edge, before it penetrates to the center of the plasma,. Even if FWCD does not prove to be better than LMCD, experiments comparing the two methods on large tokamaks should help resolve an outstanding question of explaining the success of LHCD, which is how waves of high parallel phase velocity can excite a large current when there are virtually no electrons in the velocity gap between the antenna's spectrum of ω/k and the thermal bulk.

8756 **Plasma heating by collisional magnetic pumping.** Laroussi, M.; Roth, J.R. (UTK Plasma Science Lab., Dept. of Electrical Engineering, Univ. of Tennessee, Knoxville, TN 37996-2100). pp 91 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Collisional magnetic pumping is achieved by wrapping an exciter coil around a cylindrical plasma and perturbing the confining magnetic field, $B = B_0(1 + \partial f(t))$, where f(t) is a bounded periodic function with a frequency below the ion cyclotron frequency. The transfer of energy between the perpendicular and parallel components of the ion velocity occurs through collisions. The change in the energy of the particles is governed by a homogeneous linear differential equation with periodic coefficients.

8757 **Heavy ion beam probing.** Connor, K.A.; Carnevali, A.; Crowley, T.P.; Forester, J.; Hickok, R.L.; Jennings, W.C.; Lewis, J.F.; Masucci, J.; Michael, J.D.; Misium, J.R. (Rensselaer Polytechnic Institute). pp 93 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Heavy ion beam probes have been used successfully to make measurements of potential, density, and temperature on a variety of magnetic confinement devices (tokamaks, bumpy tori, mirrors) or moderate size (eg. ISX). Work is presently under way to extend the capabilities of this diagnostic by applying it in new or larger geometries and to obtain new measurements. The most significant of the new geometries is the stellarator. Beam probes are being designed for the ATF torsatron (ORNL) and Heliotron-E (Kyoto); they are also under consideration for application on stellerators elsewhere. Possible application on larger devices is under investigation. New measurements being developed include rapid temperature profile scans and simultaneous measurements of fluctuating potential, density, and temperature. The two most significant characteristics of the torsatron field of ATF not found with tokamak fields are the large toroidal separation (15°) of the vertical and horizontal ports made necessary by the helical windings and the large magnetic field (greater than 100 G) outside the device produced by the more open ceil. The former causes a dispersion in ion trajectories that cannot be accommodated by the type of parallel plate electrostatic energy analyzer used on previous beam probes to determine the plasma potential. The latter also makes the operation of the analyzer more difficult by adding a magnetic field to a device that should have only a static electric field. New analyzer configurations and new operating procedures have been developed to accommodate these new design factors.

8758 **Thomson scattering electron temperature measurements in the east end cell of the Phaedrus-B tandem mirror plasma device.** Brooker, P.; Majeski, R.P.; Hershkowitz, N. (Nuclear Engineering Dept., Univ. of Wisconsin, Madison, WI 53706). pp 94 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

A new ICRF antenna set has been installed which consists of two dual half turn antennas in each end cell as well as four dual half turn antennas in the central cell with multiphasing capability. Also, higher end cell magnetic fields now make it possible to consider heating the electrons in the end cells at the fundamental frequency rather than the second harmonic. Critical to the understanding of this new configuration is the determination of the behavior of the electron temperature in the end cells as well as throughout the machine. High energy density in the end cells (T/sub i/ ≈ 1 £ ≦V, ⊂ a 5 x 10/sup 12/cm/sup -3/) makes it impossible to measure the electron temperature by standard electrostatic probes. Thompson scattering, which analyzes ruby light scattered off of the end cell electrons, is used to determine the local electron temperature. The east end cell Thomson scattering system uses a 5 joule, 30 nanosecond Q-switched ruby laser. The laser beam scattering volume is located on axis of the end cell and 5cm toward the central cell from the end cell midplane. The scattered light is collected at a 90 degree angle from the incident laser beam and is analyzed in a 5 channel triple grating polychrometer.

8759 **Techniques for using emitting probes for potential measurements in RF plasma.** Wang, E.Y.; Hershkowitz, N.; Intrator, T.; Forest, C. (Univ. of Wisconsin-Madison, Madison, WI 53706). pp 94 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

In this paper, the authors describe investigations of the effects of RF on plasma potential measurements with emitting probes and give methods for interpreting the data. The techniques correspond to the floating method and inflection point method of single emitting probes and differential emitting probe respectively. These methods are based on the time-averaged emitting probe I-V characteristics so the circuits are simple. It is also shown that the undistorted emissive probe characteristic can be obtained by "following techniques" in a plasma with large plasma potential fluctuations. A simple method of measurement of plasma potential fluctuation which makes use of the time averaged emissive I-V characteristics is given.

8760 **Measurements of electric field intensities and of the spectrum of electric fluctuations in relativistic electron beam driven turbulent plasma.** Levron, D.; Main, W.; Benford, G.; Kato, K. (Univ. of California, Irvine, CA 92717). pp 94 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Laser induced fluorescence is used to obtain data for determining magnitudes and fluctuation spectra of local electric fields within a turbulent plasma. A 600 keV, 15 ka, 1 μs, 50 ns risetime electron beam is injected into a 20 cm diameter, 60 cm long polycarbonate drift tube containing 10/sup 13/ cm /sup -3/ hydrogen or helium plasmas, constrained by a 2 kgauss axial magnetic field. The transfer of beam kinetic energy to resonant plasma modes is accompanied by large, local electric fields, the average magnitude and fluctuation spectra of which cannot be measured by physical probes. A small plasma gun containing alkaline earth carbonates is used to create plasma doped with appropriate ions, or a small 10 kV electron source is used to ionize 1 mtorr of helium gas in the drift tube. The doping ions or the helium atoms and ions are then excited by laser photons to levels sensitive to the Stark effect or to levels that yield electric field stimulated optical transitions in the vicinity of forbidden lines. A 20 MW, 20 ns XeCl excimer laser is used to pump various dyes to achieve the necessary wavelengths and photon fluxes for these experiments.

8761 **Use of self-integrating electric and magnetic probes for diagnosing intense transient fields.** Voss, D.E.; Miner, L.M.; Tune, R.L.; Adler, R.J.; Bushy, K.O.; Miera, B.M. (Air Force Weapons Lab., Albuquerque). pp 95 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Typical electric field sensors for pulse-power applications utilize capacitive coupling and are usually operated as intrinsically differential probes. Rogowski and B loops are also differential since their output is proportional to the time rate-of-change of the enclosed flux. When the signal from this class of detectors drives an oscilloscope directly, without use of an external integrator, the upper 50% of the oscilloscope's bandpass is not effectively utilized. This follows by nothing that if the field being measured has a step-risetime of tau, then the associated risetime from a differential probe is approximately tau/2. To avoid scope distortion, the quantity tau/2 should be greater than the scope risetime. Thus, the use of a differential-type sensor limits the overall sensor/scope bandpass to half of what it would be if a nondifferentiating sensor was used. In order to avoid artificially decreasing the signal risetime, or equivalently, artificially increasing the signal bandwidth, either self-integrating probes or external integrators coupled with differential probes should be used. Such probes, with bandpass exceeding 1 GHz, are described here.

8762 **Whistler mode electron cyclotron emission from a tandem mirror with hot electrons.** Lasnier, C.J. College Park, MD; Univ. of Maryland (1985). 197p. University Microfilms Order No. 86-14,250.

Thesis (Ph. D.).

Microwave emission in the axial direction was observed at the electron cyclotron frequency in the Tandem Mirror Experiment Upgrade (TMX-U) device. Temporal behavior of the signal and comparison of the spectrum and intensity with a computer model show the radiation to be whistler-mode electron cyclotron emission from energetic (20-250 keV) mirror-trapped electrons. Comparisons with x-ray data show the emission intensity to be approximately proportional to the hot electron temperature, as predicted by theory. Features of the emission were discovered that yield information about the spatial distribution of hot electrons. When substantial densities of cooler electrons are present in addition to the hot component, the emission is attenuated by the cold electrons by a factor depending on the cold electron density. This observed behavior agrees with computer simulations of the time evolution of the emission during shots. The temporal behavior of the emission has also been successfully simulated for shots which have mainly hot electrons and a negligible cold electron component. Relativistically correct analytical and computer modeling of whistler-mode electron cyclotron emission is demonstrated for several types of non-Maxwellian electron energy distributions, including several types of loss cones and high-energy tails.

8763 **Elliptical X-ray analyzer spectrograph application to a laser-produced plasma.** Tanaka, T.J.; Palmer, M.A.; Henke, B.L. (Test planning and diagnostics Div. 7112, Sandia National Labs.). pp 98-106 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

A preliminary experimental study was conducted on the application of an elliptical analyzer spectrograph to X-ray diagnostics of pulsed plasmas. This spectrograph was designed to record a range of 100-2000 eV X-rays on calibrated Kodak RAR-2497 film. Using point calibrations and theoretical models, the spectrograph efficiency was predicted. A 20 J, 6 ns duration Nd:glass laser pulse was focussed upon planar targets of gold, aluminum, teflon and boron carbide. Sample spectra for line and X-ray yields analysis are presented.

8764 **LSM-based x-ray diagnostics for magnetic fusion energy applications.** Franco, E.D.; Boyle, M.J. (Advanced Research and Applications Corp., 1223 E. Arques Avenue, Sunnyvale, CA 94086). pp 354-359 of Applications of thin film multilayered structures to figured x-ray optics. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

The use of layered synthetic microstructures (LSMs) as components of a radiation-hardened x-ray diagnostic designed to observe plasma instabilities in magnetic fusion energy (MFE) devices is discussed. Off-axis paraboloidal LSM optics are analytically evaluated as a means of mitigating the neutron- and gamma-induced detector noise and damage associated with deuterium-tritium operation that afflict direct line-of-sight instruments. Neutron-induced LSM damage is experimentally observed at a 14 MeV neutron fluence of 3.3 x 10/sup 14/ n/cm/sup 2/.

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REFER ALSO TO CITATION(S) 8442

8765 **(CONF-851102—115) Effects of enhanced elongation and paramagnetism on the parameter space of the ignition spherical torus.** Strickler, D.J.; Peng, Y-K.M.; Borowski, S.K.; Selcow, E.C.; Miller, J.B. (Oak Ridge National Lab., TN (USA); Grumman Aerospace Corp., Bethpage, NY (USA); Tennessee Univ., Knoxville (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002192.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The Ignition Spherical Torus (IST) is a small aspect ratio device retaining only indispensable components along the major axis of a tokamak plasma, such as a cooled, normal conductor producing a toroidal magnetic field. The IST is expected to be a cost-effective approach to ignition by taking advantage of low field, large natural plasma elongation, high plasma current, high beta, and tokamak confinement. These result in compact, high-performance devices with relatively simple magnetic systems as compared with ignition tokamaks of larger aspect ratio. The plasma enhancement of the toroidal field on axis, or plasma paramagnetism, is significant in the IST. The use of this plasma-enhanced field in conventional tokamak beta and density limits leads to increased plasma pressure and performance and therefore smaller device size for a given ignition margin.

8766 **(CONF-860652—31) Experimental and analytical investigations of magnetohydrodynamic flows near the entrance to a strong magnetic field.** Picologlou, B.F.; Reed, C.B.; Dauzvardis, P.V. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). 1986. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001552.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

An experimental program on liquid metal MHD phenomena relevant to blanket engineering is being carried out at ANL's ALEX facility. The experiments carried out at the facility are aimed towards detailed measurements of 3-D MHD flow characteristics to enlarge the existing data base and to provide validation of existing analytical approaches. Results of the first series of experiments, dealing with three dimensional MHD effects in a circular thin conducting wall duct in the fringing field of a strong transverse magnetic field, are reported. Comparison of the experimental data with the predictions of pretest analysis both supports the basic premises on which the analysis is based and suggests possible improvements.

8767 **(CONF-860917—9) Description of the heliac TJ-II and its ECRH system.** Perea, A.; Martin, R.; Alvarez Rivas, J.L.; Botija, J.; Cepero, J.R.; Fabregas, J.A.; Guasp, J.; Lopez Fraguas, A.; Perez-Navarro, A.; Solano, E.R. (Oak Ridge National Lab., TN (USA); Junta de Energia Nuclear, Madrid (Spain)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001695.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

This paper describes the main engineering aspects of the flexible heliac TJ-II, as well as the ECRH scheme that will be used for initial operation. Previous papers have described the physics of the device.

8768 **(CONF-861019—12) Development of a hydrogen electrothermal accelerator for plasma fueling.** Schuresko, D.D.; Milora, S.L.; Combs, S.K.; Foust, C.R.; Argo, B.E.; Barber, G.C.; Foster, C.A.; Ponte, N.S. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001823.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

We have developed a prototype high velocity pneumatic pellet injector which utilizes hydrogen plasma propellant generated in a high current arc discharge. A single barrel pneumatic pellet gun has been fitted with a cylindrical arc chamber interposed between the hydrogen propellant inlet valve and the gun breech. The chamber incorporates a ceramic insert for generating vortex flow in the incoming gas stream, which provides azimuthal arc stabilization. The arc is initiated after the propellant valve opens and the breech pressure starts to rise; a typical discharge lasts 150-300 microseconds with peak currents up to 2 kA. The gun has been operated with 4mm diameter by 6 to 11 mm long deuterium and hydrogen pellets. At 100 bar breech pressure (hydrogen propellant), the arc characteristics are $\langle V \rangle$ = 350 to 800 V, $\langle I \rangle$ = 600 A, so that 60 to 150 joules of electrical power is dissipated. Pellet speeds increase by 300 to 500 m/s depending on the projectile mass, which typically represents a 10 joule increment in the pellet kinetic energy. Velocities up to 1.7 km/s for deuterium pellets and 2.0 km/s for hydrogen pellets have been achieved. Comparing these data to muzzle velocities calculated from lossless, one-dimensional compressible flow gun theory demonstrates that substantial propellant heating, resulting in increased propellant sound speed, has been achieved.

8769 **(CONF-8609135—6) Muon-catalyzed fusion experiments at LAMPF.** Caffrey, A.J.; Anderson, A.N.; Van Siclen, C.D.W.; Watts, K.D.; Bradbury, J.N.; Gram, P.A.M.; Leon, M.; Maltrud, H.R.; Paciotti, M.A.; Jones, S.E. (Idaho National Engineering Lab., Idaho Falls (USA); Los Alamos National Lab., NM (USA); Brigham Young Univ., Provo, UT (USA)). 1986. Contract AC07-76ID01570;W-7405-ENG-36. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87000544.

From International symposium on muon-catalyzed fusion; Tokyo, Japan (1 Sep 1986).

Our collaboration has conducted a series of muon-catalysis experiments over broad temperature and density ranges at the LAMPF accelerator in Los Alamos. We have discovered surprising effects on the normalized muon-catalysis cycling rate, λ/sub c/, and the apparent alpha-particle sticking coefficient, ω/sub s/, that depend on the d-t mixture density. This paper reviews our experimental approach, analysis methods, and results for tests with targets varying in density from 0.12 to 1.30, normalized to liquid hydrogen density, and in temperature from 15K to 800K. In particular, results will be presented on the cycling rate, sticking coefficient, and ^{3}He scavenging rate, as functions of temperature, mixture density, or tritium concentration.

8770 **(DOE/ER/52109—T3) External wave launcher study. Final technical report.** Moses, K.G. (JAYCOR, Torrance, CA (USA)). 26 Jun 1986. Contract AC03-84ER52109. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87000636.

The overall purpose of this study is to explore the applicability of dielectric filled waveguide launchers to couple ion cyclotron resonant frequency (ICRF) power to magnetically confined plasma. The major advantage of dielectric filled launchers is that the geometrical dimensions of a waveguide launcher required to accommodate an electromagnetic wave of any given frequency can be reduced by the square root of the relative permittivity of the dielectric compared to air or vacuum waveguide dimensions. However, removal of the intense heat load deposited by 14 MeV neutrons in a solid dielectric filled waveguide heating system in close proximity to a fusion reactor presents several major problems: Heat is distributed throughout the volume of solid dielectric by energetic neutrons, which necessitates that a substantial fraction of the dielectric filled waveguide must be occupied by channels containing liquid

coolant to remove the heat. The uniformity of the internal dielectric media of the waveguide is disrupted, and electromagnetic waves in the guide will be reflected and scattered at the discontinuities. It is highly questionable that a waveguide or waveguide launcher constructed in this manner will be an efficient means of transmitting ICRF power. This circumstance leads to employing liquid dielectrics which could satisfy both electromagnetic and coolant requirements of ICRF auxiliary launching systems simultaneously. Additionally, liquid dielectrics facilitate the motion of tuning structures through the media and preserve its dielectric uniformity in contrast to the tuning restrictions imposed by solid dielectrics in this regard.

8771 **(EGG-M—33986) Implications of recent implantation-driven permeation experiments for fusion reactor safety.** Longhurst, G.R.; Anderl, R.A.; Struttmann, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 16p. (CONF-8610157—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002600.

From Tritium technology workshop; Tokyo, Japan (22 Oct 1986).

Metal structures exposed to the plasma in tritium-burning fusion reactors will be subject to implantation-driven permeation (IDP) of tritium. Permeation rates for IDP in fusion structural materials are usually high because the tritium atoms enter the material without having to go through the dissociation and solution steps required of tritium-bearing gas molecules. These surface processes, which may be rate limiting in PDP, actually enhance permeation in IDP by inhibiting the return of tritium to the plasma side of the structure. Experiments have been conducted at the Idaho National Engineering Laboratory (INEL) to investigate the nature of IDP by simulating conditions experienced by structures exposed to the plasma. These experiments have shown that surface conditions are important to tritium permeation in materials endothermic to hydrogen solution such as austenitic and ferritic steels. In reactive metals such as vanadium, surface processes appear to totally control the permeation. The purpose of this paper is to review the progress of those experiments and to discuss the implications that the results have regarding the tritium-related safety concerns of fusion reactors.

8772 **(LA-UR—86-3558) Overview of tritium processing development at the tritium systems test assembly.** Anderson, J.L. (Los Alamos National Lab., NM (USA)). 22 Oct 1986. Contract W-7405-ENG-36. 10p. (CONF-8610157—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001965.

From Tritium technology workshop; Tokyo, Japan (22 Oct 1986).

The Tritium Systems Test Assembly (TSTA) at the Los Alamos National Laboratory has been operating with tritium since June 1984. Presently there are some 50 g of tritium in the main processing loop. This 50 g has been sufficient to do a number of experiments involving the cryogenic distillation isotope separation system and to integrate the fuel cleanup system into the main fuel processing loop. In January 1986 two major experiments were conducted. During these experiments the fuel cleanup system was integrated, through the transfer pumping system, with the isotope separation system, thus permitting testing on the integrated fuel processing loop. This integration of these systems leaves only the main vacuum system to be integrated into the TSTA fuel processing loop. In September 1986 another major tritium experiment was performed in which the integrated loop was operated, the tritium inventory increased to 50 g and additional measurements on the performance of the distillation system were taken. In the period June 1984 through September 1986 the TSTA system has processed well over 10^6 Ci of tritium. Total tritium emissions to the environment over this period have been less than 15 Ci. Personnel exposures during this period have totaled less than 100 person-mRem. To date, the development of tritium technology at TSTA has proceeded in progressive and orderly steps. In two years of operation with tritium, no major design flows have been uncovered.

8773 **(LRP—229/83) Limiter design and material tests in TCA with Alfven Wave Heating.** Hofmann, F.; Hollenstein, C.; Joye, B.; Lietti, A.; Lister, J.B.; Nowak, S.; Peacock, N.J.; Pochelon, A.; Stamp, M.F. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland); UKAEA Culham Lab., Abingdon; Fribourg Univ. (Switzerland)). Jan 1985. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900119.

Serious impurity problems were encountered during the initial Alfven Wave Heating experiments in TCA. We have tested several new limiters with considerable resulting improvement. Replacing the narrow steel bar limiters by wide, carefully profiled steel limiters led, surprisingly, to a much worse radiation dominated performance. Wide carbon limiters and TiC coated carbon limiters were then installed. The latter gave the lowest Z/sub eff/ but a peaked radiated power profile. We finally installed narrower pure carbon limiters with which the rf experiments could be advanced.

8774 **(LRP—255/85) Evaluation of SiC-coated carbon limiters in the TCA tokamak.** Hofmann, F.; Hollenstein, C.; Joye, B.; Lister, J.B.; Marcus, F.B.; Nowak, S.; Pochelon, A.; Todd, T.N. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland); Fribourg Univ. (Switzerland); UKAEA Culham Lab., Abingdon). Aug 1985. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900183.

Carbon limiters coated with 100 to 150 μm of silicon carbide (SiC) have been placed in the TCA tokamak in an attempt to reduce impurity generation during both ohmic and Alfven wave heating. The results are compared with those with bare carbon limiters operated under similar conditions. The SiC coated limiters were conditioned by 150 hours of Taylor discharge cleaning. During both ohmic and Alfven wave heating, the radiation profile is strongly hollow, with no measurable radiated power on axis. The light impurity line emission intensities are reduced by factors of 3 to 10 for C, N and O, while the intensity of the silicon line emission naturally increased. During Alfven wave heating, the density of metallic impurities is less than with bare carbon limiters. Z/sub eff/ dropped from 4.2 to 2.4, and the loop voltage fell from 1.5 to 1 V. The relative drop in plasma resistivity and radiated power is largest at higher electron density ($5 \times 10^{13} cm^{-3}$). The plasma operational range is similar to that obtained using bare carbon limiters. In conclusion, the SiC coated limiters have led to significant improvements in plasma performance due to impurity reduction.

8775 **(ORNL/TM—9994) ELMO Bumpy Square proposal.** Dory, R.A.; Uckan, N.A.; Ard, W.B.; Batchelor, D.B.; Berry, L.A.; Bryan, W.E.; Dandl, R.A.; Guest, G.E.; Haste, G.R.; Hastings, D.E. (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 397p. NTIS, PC A17/MF A01. File Number DE87002953.

The ELMO Bumpy Square (EBS) concept consists of four straight magnetic mirror arrays linked by four high-field corner coils. Extensive calculations show that this configuration offers major improvements over the ELMO Bumpy Torus (EBT) in particle confinement, heating, transport, ring production, and stability. The components of the EBT device at Oak Ridge National Laboratory can be reconfigured into a square arrangement having straight sides composed of EBT coils, with new microwave cavities and high-field corners designed and built for this application. The elimination of neoclassical convection, identified as the dominant mechanism for the limited confinement in EBT, will give the EBS device substantially improved confinement and the flexibility to explore the concepts that produce this improvement. The primary goals of the EBS program are twofold: first, to improve the physics of confinement in toroidal systems by developing the concepts of plasma stabilization using the effects of energetic electrons and confinement optimization using magnetic field shaping and electrostatic potential control to limit particle drift, and second, to develop bumpy toroid devices as attractive candidates for fusion reactors. This report presents a brief review of the physics analyses that support the EBS concept, discussions of the design and expected performance of the EBS device, a description of the EBS experimental program, and a review of the reactor potential of bumpy toroid configurations. Detailed information is presented in the appendices.

8776 **(ORNL/TM—10096) Plasma-Materials Interactions Test Facility.** Uckan, T. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002966.

The Plasma-Materials Interactions Test Facility (PMITF), recently designed and constructed at Oak Ridge National Laboratory (ORNL), is an electron cyclotron resonance microwave plasma system with densities around 10^{11} cm^{-3} and electron temperatures of 10-20 eV. The device consists of a mirror cell with high-field-side microwave injection and a heating power of up to 0.8 kW(cw) at 2.45 GHz. The facility will be used for studies of plasma-materials interactions and of particle physics in pump limiters and for development and testing of plasma edge diagnostics.

8777 **(ORNL/TM—10171) Heliac equilibria.** Hender, T.C.; Carreras, B.A.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002967.

Three-dimensional numerical calculations of Heliac equilibria are presented. The results indicate that finite-β distortions in the flux surfaces can arise due to the presence of low order rational surfaces within or near the plasma. These distortions arise because of nonlinear beatings between the toroidal shift and the helical components of the magnetic field. Reducing the toroidal shift by increasing the number of field periods and/or the aspect ratio improves the equilibrium β-limit.

8778 **(PPPL—2389) Physics aspects of the Compact Ignition Tokamak.** Post, D.; Bateman, G.; Houlberg, W.; Bromberg, L.; Cohn, D.; Colestock, P.; Hughes, M.; Ignat, D.; Izzo, R.; Jardin, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1986. Contract AC02-76CH03073. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002954.

The Compact Ignition Tokamak (CIT) is a proposed modest-size ignition experiment designed to study the physics of alpha-particle heating. The basic concept is to achieve ignition in a modest-size minimum cost experiment by using a high plasma density to achieve the condition of ntau/sub E/ $\sim 2 \times 10^{20}$ sec m^{-3} required for ignition. The high density requires a high toroidal field (10 T). The high toroidal field allows a large plasma current (10 MA) which improves the energy confinement, and provides a high level of ohmic heating. The present CIT design also has a gigh degree of elongation ($k \sim 1.8$) to aid in producing the large plasma current. A double null poloidal divertor and a pellet injector are part of the design to provide impurity and particle control, improve the confinement, and provide flexibility for impurity and particle control, improve the confinement, and provide flexibility for improving the plasma profiles. Since auxiliary heating is expected to be necessary to achieve ignition, 10 to 20 MW of Ion Cyclotron Radio Frequency (ICRF) is to be provided.

8779 **(UCRL—15849) Generation of stable Ps, mJ pulses at high repetition rate for ultrafast diagnostic experiments: Final report.** Mourou, G. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Oct 1986. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002683.

Nd:Glass amplifiers have very good energy storage capabilities (5 J/cm^2), but, the energy extraction is extremely inefficient for short-pulse amplification. At relatively high peak intensities of $\sim$ 10 GW/cm^2, nonlinear phase shifts occur, leading to beam wavefront distortion which can result in filamentation and irreversible damage. In order that the peak intensity in the amplifier remain below this damage level, a picosecond pulse can be amplified only to an energy density of $\sim$ 10 mJ/cm^2, two orders of magnitude less than the stored energy level of 5 J/cm^2. We have developed an amplification system, which uses an optical pulse compression technique to circumvent this peak power limitation. This technique is analogous to a method developed over forty years ago for the amplification of radar pulses. Briefly: a long optical pulse is deliberately produced by stretching a short, low-energy pulse, amplified and then compressed. The frequency chirp and the temporal broadening are produced by propagating a high-intensity pulse along a single-mode fiber. At the beginning of the fiber, the pulse undergoes self-phase modulation which produces a frequncy chirp. The chirp is then linearized by the group-velocity dispersion of the fiber. This long, frequency-chirped, pulse is amplified, and then compressed to a pulsewidth approximately equal to $1/\Delta f$, where Δf is the chirped bandwidth. With this system, short pulses can reach the high saturation energy levels, with moderately low peak power levels being maintained in the amplifying medium.

8780 **Miniature plasma accelerating detonator and method of detonating insensitive materials.** Bickes, R.W. Jr.; Kopczewski, M.R.; Schwarz, A.C. (to Dept. of Energy, Washington, DC). US Patent 4,621,577. 11 Nov 1986. Filed date 4 Jan 1985. v.p.

This patent describes a detonator assembly for initiating insensitive explosives or energetic materials. In the improvement described here the detonator assembly comprises: railgun accelerating means of a size sufficient to be used as a detonator for insensitive explosives or energetic materials in an amount of about 100 mg of explosives or less and capable of accelerating a plasma to detonation initiating velocities; and power supply means for supplying the power necessary to the railgun accelerating means to generate and accelerate the plasma.

8781 **Utility of spectral measurements of secondary reaction products.** Heidbrink, W.W. (Princeton Univ., NJ, USA. Plasma Physics Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **248**: No. 2/3, 499-500(1 Aug 1986).

The spectra of 15 MeV protons and 14 MeV neutrons producted in the burnup of 0.8 MeV ^{3}He ions and 1 MeV tritons through the $d(^3He,p)\alpha$ and $d(t,n)\alpha$ fusion reactions contain information on the velocity distributions of the energetic ^{3}He ions and tritons.

8782 **Inertial fusion power for space applications.** Meier, W.R.; Hogan, W.J.; Hoffman, N.J.; Murray, K.A. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 1842-1848 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—). Contract W-7405-ENG-48.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

It is now considered very likely that within the next ten years, inertial confinement fusion (ICF) will have achieved high (10-100) gain (ratio of fusion energy produced to driver energy on target) in the laboratory. Current ICF power plant designs, based upon the most technologically advanced earthbound drivers, tend to be very high power ($\approx$1000 MW/sub e/) and heavy (the Nova laser weighs about 500 tons without the building). Space power needs are currently much smaller than this (but are growing), and the space application places a premium on low mass and high efficiency. This paper evaluates current ICF driver and reactor alternative technologies using space power criteria. The authors also consider how current technologies might be altered to produce smaller, lighter fusion power sources for space. It is shown that the technologies currently leading for terrestrial application (emphasizing low development risk and low cost) are not the best ones for space power; however, technologies are identified that would result in attractive ICF space power plants an order of magnitude less massive.

8783 **Flashover lithium ion source development.** Bieg, K.W.; Burns, E.J.T.; Keleer, J.; Loubriel, G. (Sandia National Labs.). pp 33 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

The authors have found that water and hydrocarbon surface contaminants (adsorbates) contribute over one-half of the ion beam current extracted from an uncleaned lithium flashover source. They

have developed methods to generate high purity (85%) lithium ion beams from these sources, either by vacuum baking combined with glow discharge cleaning, or by in-situ deposition of the ion source material. However, concurrent with this improvement, they have observed a significant decrease in the extracted ion current, from over 1.2KA/cm/sup 2/ from an epoxy source to less than 0.3KA/cm/sup 2/ from a cleaned lithium dielectric flashover source. The authors believe this high impedance diode behavior reflects the difficulty with which lithium is desorbed from an ionic lithium dielectric material compared to the easily desorbed adsorbates. This observation is supported by recent ESD and PSD studies which show that the vast majority of lithium is desorbed from LiF as ground state, neutral lithium via a slow thermal process (compared to the 40 ns diode power pulse). Several methods have been suggested to improve this situation.

99 GENERAL AND MISCELLANEOUS

8784 **(DOE/MA—0264) Listing of awardee names. Inactive awards as of October 31, 1986.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Procurement and Assistance Management Directorate). 31 Oct 1986. 459p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE87002515.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award is earlier (in the past) than the date of the issuance of the listing.

8785 **(UCID—20910) Additional results of the simulation of large-scale urban fires using the LUF code.** Reitter, T.A. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002837.

The LUF urban fire code has been modified and applied to three unrelated problems: fire-induced winds, simulation of the Great Sakata fire of 1976, and simulation of fire in the San Jose, California urban area using fuel distribution for 1980.

9901 Management

8786 **(CONF-8610146—4) DSS in perspective: an examination of essential success factors.** Barnes, R.W.; Emrich, M.L. (Oak Ridge National Lab., TN (USA)). 10 Oct 1986. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002171.

From Southeastern TIMS meeting; Myrtle Beach, SC, USA (9 Oct 1986).

A variety of approaches to the development and use of decision making information has been advocated and labeled DSS. This study examines a number of reported examples of decision support system methodologies and applications, and identifies certain significant differentiating characteristics. By analyzing managerial roles and styles in conjunction with DSS characteristics, essential success factors are determined. 12 refs., 3 tabs.

8787 **(DOE/IG—0008/10-2) Office of Inspector General semiannual report to the Congress, April 1 to September 30, 1986.** (USDOE Office of Inspector General, Washington, DC). Nov 1986. 42p. OSTI, PO Bx 62, Oak Ridge, TN 37831. File Number TI87003044.

During this reporting period, the Office of Inspector General (OIG) continued to pursue monetary savings or a dollar driven strategy in the performance of its mission. OIG reports issued during this period contained recommendations that, if implemented, could result in the more efficient use of about $195.4 million of Departmental resources or other improved management actions. DOE management made commitments during this reporting period to recover $12.9 million in unjustified charges from its contractors and committed to more efficient use of funds totaling another $48.3 million.

8788 **(DOE/IG—0010/3) Annual work plan for FY 1987.** (USDOE Office of Inspector General, Washington, DC). 30 Sep 1986. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86015885.

This document is the result of a continuing planning process which is based upon our updated study of DOE audit needs. Although the resource levels recommended by the study are not feasible in the current Federal budget climate, we have used the study findings to determine the appropriate mix of audit effort within the available audit resources and refine our audit targeting to coincide with the program priorities as expressed in the departmental budget. Additionally, in FY 1986 we began updating our workplan on a quarterly basis. This allows us to be more responsive to audit requests from the Department and to reallocate our resources based on changing priorities during the plan year.

8789 **(DOE/IG—0232) Report on the coordination of long-term energy research and development planning.** (USDOE Office of Inspector General, Washington, DC). 25 Nov 1986. 34p. OSTI, PO Bx 62, Oak Ridge, TN 37831. File Number TI87002865.

We found that the requirement for major programs to develop R & D program plans has never been promulgated in writing. As a result, not all programs develop 5-year program plans and those that do often use quite different formats. Some plans include financial data and milestones and some do not. Programs that develop program plans do not all use the same general R & D goals and objectives in developing the plans. No single office in DOE regularly receives and reviews all program plans. Further, there is no systematic approval process within the Department for program plans. Some plans are left in draft form and are never published as final plans. As a result of these findings, we conclude that the Department does not adequately coordinate the development of the long-term energy R & D plan. Three recommendations are made: (1) promulgate a directive that defines how energy R & D program planning is to be done; (2) provide more specific guidance on energy R & D goals and objectives to developers of program plans; and (3) submit copies of program plans to a single office, the Office of Energy Research, for review for gaps and duplications.

8790 **(OEFZS—4323e) Progress Report 1984 of the Austrian Research Centre Seibersdorf. Abridged version.** Schwach, G.W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Stabsabteilung Forschungsplanung und Technologieprognose). Jun 1986. 27p. (FO—35/86). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700239.

Translated from OEFZS–4323, FO–33/85, May 1985, Seibersdorf, Austria.

The report gives a short survey of the work carried out by the Austrian Research Centre Seibersdorf in 1984. The working programme comprises five main areas: Energy and safety; Materials research, isotope and radiation techniques; Measuring techniques and information processing; Environmental protection, health and food; Industrial consulting.

8791 **(OEFZS—4365) Progress Report 1985 of the Austrian Research Centre Seibersdorf. Abridged version.** Schwach, G.W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Stabsabteilung Forschungsplanung und Technologieprognose). Jun 1986. 32p. (In German). (FO—34/86). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700240.

The report gives a short survey of the work carried out by the Austrian Research Centre Seibersdorf in 1985. The working programme comprises five main areas: Energy and safety; Materials research, isotope and radiation techniques; Measuring techniques and information processing; Environmental protection, health and food; Industrial consulting.

8792 **(ORNL/DSRD/TM—1) AFWIS/Project 6000 integration plan: Interim draft.** Loebl, A.S. (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 117p. NTIS, PC A06/MF A01; GPO Dep. File Number DE87002989.

This is an update to the Preliminary Systems Integration Plan (ORNL/TM-9607) issued June 1985. This AFWIS Integration Plan is intended to provide an explanation of the Air Force's AFWIS/Project 6000 Programs that the Martin Marietta Energy System's Data Systems Research and Development (DSRD) Program is currently directing. As a complement to the work which has been undertaken and to ensure acceptance of the Energy Systems approach to the AFWIS/Project 6000 programs, this document is intended to describe the work and strategy to DOE, Energy Systems, and other interested parties.

8793 **(ORNL/TM—10243) Computer aided instruction for the Naval Aviation Logistics Data Analysis System: Interim report.** Duncan, L.D.; Handler, B.H.; Sparks, S.G. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002982.

Oak Ridge National Laboratory personnel are researching the applicability of computer aided instruction for the Naval Aviation Logistics Data Analysis (NALDA) System. The objective of this project is to correct the deficiencies outlined in the NALDA Mission Elements Needs Statement (MENS), dated January 22, 1986. The project is divided into two phases. This report follows the completion of the first two tasks in phase one. The purpose of these tasks was to (1) determine the scope of the investigation and to identify representative sites and target audiences, and (2) investigate current operations, including existing software and hardware, current training curricula, user operator procedures, and specific deficiencies that may be improved. Site visits and user interviews have been completed and the resulting data have been entered into a database which was used as an analysis tool in building a generic profile of user needs. This interim report discusses the data gathered from current NALDA users in connection with their experiences in learning and using the system. A prioritized list of needs and requirements of the NALDA user community is included.

8794 **(ZfI-Mitt—112) Scientific report of the Central Institute for Isotope and Radiation Research.** Lubert, K.H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Jun 1986. 295p. (In English and German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87700238.

The publications, lectures, and poster presentations of the Zentralinstitut fuer Isotopen- und Strahlenforschung in the year 1985 are presented as abstracts. Author and subject indexes are included.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 8580, 8717

8795 **(AD-A—172497/0/XAB) Expert system for tutoring intelligence analysts. Master's thesis.** Melvin, R.O. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Jun 1986. 133p. (AFIT/GST/ENSS—86M-14). NTIS, PC A07/MF A01.

Intelligent Computer Aided Instruction (ICAI) allows a computer to perform some of the functions normally performed by a human instructor. This thesis describes the design and implementation of an ICAI system which presents radar principles to a student, tests him, finds out why he made an error, and then corrects the error. To allow the system to be used for different subject domains, the knowledge required to teach was kept separate from the knowledge about the subject domain. During the design phase, the knowledge about teaching was partitioned into eight knowledge bases, the functions of these knowledge bases were described, and their interactions with one another were shown. During the implementation phase, each knowledge base was developed separately before being integrated into the system. Of these eight knowledge bases, the knowledge base that tests the student received the major emphasis. This knowledge base generates a multiple-choice question, finds the answer, and creates plausible incorrect answers to serve as distractors. Although the radar range equation was used to test this knowledge base, this knowledge base performs the same functions with any equation which is entered into the system in its canonical form. Although this thesis establishes the framework for an ICAI system and then demonstrates its feasibility, further research is required before the system can be used in an actual training environment.

8796 **(ANL/MCS-TM—80) ELEFUNT test results under NS32000 Fortran V2.5.3 on the Sequent Balance.** Cody, W.J. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002747.

In January 1986 a Sequent Balance Computer was installed in the Mathematics and Computer Science Division's Advanced Computing Research Facility (ACRF). In July 1986 the system consisted of 4 processors sharing 8 megabytes of memory. This paper summarizes and analyzes the results of running various programs designed to test the arithmetic and the Fortran elementary and intrinsic function packages on that machine. The programs run include MACHAR and the ELEFUNT suite of transportable Fortran test programs from the Software Manual for the Elementary Functions by Cody and Waite [1980], the Fortran version of the arithmetic test program PARANOIA {Karpinski, 1985], and prototype programs from the nascent INTFUNT test suite for intrinsic functions. All tests were run using NS32000 Fortran V2.5.3 under the DYNIX V2.0.1 operating system (based on 4.2 BSD UNIX. 8 refs., 4 tabs.

8797 **(DOE/ER/25001—9) Speedup bounds and processor allocation for parallel programs on multiprocessors.** Polychronopoulos, C.D.; Banerjee, U. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development; Control Data Corp., Sunnyvale, CA (USA)). Feb 1986. Contract FG02-85ER25001. 29p. (CONF-860877—3; CSRD—551). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002099.

From International conference on parallel processing; St. Charles, IL, USA (19 Aug 1986).

The main aim of this paper is to study allocation of processors to parallel programs executing on a multiprocessor system, and the resulting speedups. We first consider a general program represented as a sequence of steps consisting of parallel operations, then one represented as a task graph whose nodes are do across loops and whose edges represent precedence constraints, and finally a single do across loop. General bounds on program speedup are discussed and measurements of code parallelism for the LINPACK numerical package are presented. 11 refs., 4 figs.

8798 **(ENEA-RT/PAS—86/2) Orthogonal polynomial estimates for point process densities.** Vere-Jones, D.; Musmeci, F. (Victoria Univ., Wellington (New Zealand); ENEA, Casaccia (Italy). Dipartimento Protezione Ambientale e Salute dell'Uomo). Jan 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900155.

An algorithm is described for estimating first order densities by an approximate finite series expansion in orthogonal polynomials. It is based on the use of maximum likelihood estimates for the coefficients in the expansion, together with the use of the AIC stopping rule to determine the number of coefficients included. Examples are given of estimating Poisson densities in 1-(time), 2-(space) and 3-(space-time) dimensions. A procedure for discussing space-time independence is described. Extensions are discussed for estimating first order densities in certain types of non-homogeneous cluster processes.

8799 **(ENEA-RT/PAS—86/3) A variable grid algorithm for smoothing clustered data.** Musmeci, F.; Vere-Jones, D. (ENEA, Casaccia (Italy). Dipartimento Protezione Ambientale e Salute dell'Uomo; Victoria Univ., Wellington (New Zealand)). Jan 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900156.

An algorithm is described for smoothing data points on the plane. The observation region is divided into cells and each group of 4 adjoining cells is tested to see whether it can be accepted that the values in the cells come from a distribution with the same underlying value of the parameter. If so, the cells are grouped again in a further round of smoothing. If not, the original values are retained and no further smoothing involving those cells takes place. The method is applied to these typical situations: smoothing of count data assumed to follow a non-homogeneous Poisson process; smoothing of count data assumed to follow a negative binomial process with non-homogeneous rate; smoothing of data representing point values from an exponential distribution with spatially varying mean. 5 refs., 4 figs.

8800 **(INP—1212/PM) Standard deviation of the intersection point for two statistically uncertain curves.** Krynicka-Drozdowicz, E. (Institute of Nuclear Physics, Krakow (Poland)). 1983. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700236.

FORTRAN.

A method of estimating the standard deviation of the intersection point of two curves characterized by some statistical uncertainties is presented. The method is based on a computer simulation of deviations of the curves. An example of application of the method to estimate the accuracy of the thermal neutron macroscopic absorption cross-section measurement is described. Computer program in FORTRAN language is enclosed.

8801 **(LA-UR—86-2662) Implementation and optimization of portable standard LISP for the Cray.** Anderson, J.W.; Kessler, R.R.; Galway, W.F. (Los Alamos National Lab., NM (USA); Utah Univ., Salt Lake City (USA). Dept. of Computer Science). 1987. Contract W-7405-ENG-36. 14p. (CONF-870108—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013818.

From 20. annual Hawaii international conference on system sciences; Honolulu, HI, USA (6 Jan 1987).

Portable Standard LISP (PSL), a dialect of LISP developed at the University of Utah, has been implemented on the CRAY-1s and CRAY X-MPs at the Los Alamos National Laboratory and at the National Magnetic Fusion Energy Computer Center at Lawrence Livermore National Laboratory. This implementation was developed using a highly portable model and then tuned for the Cray architecture. The speed of the resulting system is quite impressive, and the environment is very good for symbolic processing. 5 refs., 6 tabs.

8802 **(PNL-SA—14450) A generalized coding standard and some associated tools.** Straub, E.J.; Slavich, A.L.; Winter, C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 12p. (CONF-8610128—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002471.

From Fall digital equipment computer users society symposium; San Francisco, CA, USA (6 Oct 1986).

A general coding standard which was developed to provide neat, uniform and complete documentation at the module level and some software tools which were developed to support the coding standard are described. The general coding standard is intended to be used as a tool for writing language specific coding standards. Although several language specific coding standards have been developed with this GCS, only the GCS is discussed in this paper (although tools for the FORTRAN coding standard are discussed).

8803 **(SAND—86-2468) SLEM [SLAVE Emulator Editor]: A user-friendly, advanced text editor.** Mills-Curran, W.C. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002732.

SLEM is a new full-screen editor for VAX/VMS computers which is programmed in the VAXTPU language. In addition to executing more quickly than EDT, SLEM proviees several new, advanced features while employing a user interface which is similar to EDT. The SLEM enhancements in the VAXTPU facility are like the SLAVE editor enhancements to EDT.

9903 Information Handling

8804 **(AD-A—172515/9/XAB) Response surface methodology: 1966-1986. Technical report.** Myers, R.H.; Khuri, A.I.; Carter, W.H. (Florida Univ., Gainesville (USA). Dept. of Statistics). Sep 1986. 85p. (TR—273). NTIS, PC A05/MF A01.

The authors intent is to provide a review of important developments in response surface methodology, with the definition being confined to that of a collection of tools in design or data analysis that enhance the exploration of a region of design variables in one or more responses. They emphasize developments in the statistics literature that have appeared since 1966 but make reference to some pre-1966 work where historical perspective is necessary. In terms of subject matter applications, the authors do not confine themselves to applications in the chemical and processing fields. They feel that one of the more-important items to report is the breadth of application of RSM that has evolved in the last 20 years. Applications have expanded to areas such as operations research, nuclear energy, defense systems research, cancer chemotherapy, and many others. This document reviews the spectrum from theoretical developments to practical notions of current software availability in both the design and analysis aspects of RSM: Design and analysis will be treated separately though the user must treat the two together in his total analysis. The original intent by Box and company was to highlight a strategy--both experimental and analytic. Yet precious little research employs a simultaneous consideration of both of these aspects. Finally, suggestions regarding the important areas for future research and future impact of RSM are offered.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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11	*See* CERN-EP-86-135	DE87900147	MN -22	12:8487
CONF-860826-	(National meeting of the American Institute of Chemical Engineers, Boston, MA, USA, 24-27 Aug 1986)			
7	*See* Y/DZ-231	E 1.99: DE87001637	MN -11	12:8599
9	*See* IS-M-597	E 1.99: DE87002730	MN -90i	12:7889
CONF-860870-	(13. international conference on high energy accelerators, Novosibirsk, USSR, 7-11 Aug 1986)			
14	*See* BNL-38813	E 1.99: DE87002579	MN -28	12:8476
CONF-860877-	(International conference on parallel processing, St. Charles, IL, USA, 19-22 Aug 1986)			
3	*See* DOE/ER/25001-9	E 1.99: DE87002099	MN -32	12:8797
CONF-860880-	(30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986)			
38	*See* UCRL-95556	E 1.99: DE87002385	MN -38	12:8447
CONF-860895-	(14. international conference on defects in semiconductors, Paris, France, 18-22 Aug 1986)			
7	*See* CERN-EP-86-134	DE87900145	MN -25	12:8382
CONF-8608132-	(Metabolism, function and structure of plant lipids conference, Davis, CA, USA, 25-28 Aug 1986)			
1	*See* LBL-22293	E 1.99: DE87001727	MN -48	12:7994
CONF-860905-	(International meeting on low, intermediate and high level waste management - decontamination and decommissioning, Niagara Falls, NY, USA, 14-18 Sep 1986)			
21	*See* DP-MS-86-96	E 1.99: DE87002640	MN -70	12:7967

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
CONF-860908-	(Operability of nuclear power systems in normal and adverse environments meeting, Albuquerque, NM, USA, 29 Sep-3 Oct 1986)				
33	*See* SAND-86-0738C		TI87002697	MN -78	12:8211
CONF-860914-	(Applied superconductivity conference (ASC '86), Baltimore, MD, USA, 28 Sep-4 Oct 1986)				
10	*See* LBL-22343	E 1.99:	DE87002574	MN -34C	12:8670
11	*See* LBL-22342		DE87002548	MN -28	12:8483
12	*See* LBL-21295	E 1.99:	DE87002561	MN -28	12:8512
CONF-860917-	(14. SOFT - symposium on fusion technology, Avignon, France, 8-12 Sep 1986)				
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001695	MN -20	12:8767
CONF-860918-	(7. international conference on hyperfine interactions, Bangalore, India, 8-12 Sep 1986)				
2	*See* CERN-EP-86-117		DE87900149	MN -34C	12:8708
CONF-860953-	(International conference on vacancies and interstitials in metals and alloys, Berlin, F.R. Germany, 14-19 Sep 1986)				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002168	MN -25	12:8331
4	*See* CERN-EP-86-133		DE87900142	MN -25	12:8329
CONF-860990-	(8. annual participants' information meeting of the DOE Low-Level Waste Management Program, Denver, CO, USA, 22-26 Sep 1986)				
9	*See* DP-MS-86-172	E 1.99:	DE87002654	MN -70B	12:7969
10	*See* DP-MS-86-116	E 1.99:	DE87002645	MN -70B	12:8385
11	*See* DP-MS-86-108		DE87002658	MN -70B	12:7968
CONF-8609132-	(Resonance ionization spectroscopy and its application, Swansea, UK, 7-12 Sep 1986)				
.2	*See* UCRL-94164-Rev.2	E 1.99:	DE87001363	MN -22	12:8426
(-8609135-	(International symposium on muon-catalyzed fusion, Tokyo, Japan, 1-3 Sep 1986)				
6	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87000544	MN -21	12:8769
CONF-8609147-	(American Nuclear Society annual meeting, Bethesda, MD, USA, 15-17 Sep 1986)				
2	*See* EGG-10282-1124	E 1.99:	DE87001788	MN -41	12:8587
3	*See* PNL-SA-14104	E 1.99:	DE87002064	MN -41	12:8210
CONF-8609149-	(Electrical overstress/electrostatic discharge symposium, Las Vegas, NV, USA, 23-25 Sep 1986)				
2	*See* SAND-86-1228C		DE87002480	MN -38	12:8459
CONF-8609150-	(International symposium on gallium arsenide and related compounds, Las Vegas, NV, USA, 28 Sep-1 Oct 1986)				
6	*See* LBL-22082	E 1.99:	DE87002542	MN -25	12:8387
CONF-8609176-	(Austrian Physical Society annual convention, Innsbruck, Austria, 22-26 Sep 1986)				
	See INIS-mf-10512		DE87700241	MN -34	12:8727
CONF-8609193-	(NATO advanced research workshop on acid deposition processes at high elevation sites, Edinburgh, UK, 8-12 Sep 1986)				
1	*See* ECN-86-127			ND -11	12:8562
CONF-8609194-	(ICCP working group combustion meeting, Doncaster, UK, 8-12 Sep 1986)				
1	*See* ECN-86-105			ND -90e	12:7911
CONF-8609195-	(4. European symposium on the physico-chemical behaviour of atmospheric pollutants, Stressa, Italy, 23-25 Sep 1986)				
1	*See* ECN-86-142			ND -90i	12:7897
CONF-861006-	(Nuclear power systems symposium, Washington, DC, USA, 29-31 Oct 1986)				
2	*See* BNL-38810	E 1.99:	DE87002588	MN -28	12:8485
CONF-861007-	(Nuclear science and nuclear power systems symposium, Washington, DC, USA, 29-31 Oct 1986)				
2	*See* EGG-10282-2097	E 1.99:	DE87001782	MN -37	12:8529
5	NTIS, PC A02; 3		DE87002191	MN -37	12:8527
CONF-861010-	(13. world energy conference, Cannes, France, 5-11 Oct 1986)				
3	*See* ESC-WR-86-02			ND -98	12:8313
CONF-861019-	(10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society, Baltimore, MD, USA, 27-31 Oct 1986)				
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001823	MN -21	12:8768
14	*See* SAND-86-1826C	E 1.99:	DE87002491	MN -25	12:8352
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002623	MN -34	12:8332
CONF-861044-	(Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford, Richland, WA, USA, 21-23 Oct 1986)				
3	*See* UCRL-95494	E 1.99:	DE87002384	MN -41	12:8723
CONF-861062-	(European wind energy conference, Rome, Italy, 7-9 Oct 1986)				
1	*See* ECN-86-149			ND -60	12:8139
2	*See* ECN-86-150			ND -60	12:8140
3	*See* ECN-86-153			ND -60	12:8141

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CONF-861068-	(Electrochemical Society fall meeting, San Diego, CA, USA, 19-24 Oct 1986)			
13	*See* SAND-86-2037C	E 1.99: DE87002695	MN -25	12:8392
CONF-861081-	(Workshop on automation and robotics for military applications, Huntsville, AL, USA, 22-23 Oct 1986)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002411	MN -38	12:8435
CONF-861091-	(Hypervelocity impact symposium, San Antonio, TX, USA, 21-24 Oct 1986)			
10	*See* SAND-86-2179C	DE87002496	MN -38	12:8431
CONF-8610115-	(4. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 27-31 Oct 1986)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002705	MN -34A	12:8677
CONF-8610128-	(Fall digital equipment computer users society symposium, San Francisco, CA, USA, 6-10 Oct 1986)			
4	*See* PNL-SA-14450	E 1.99: DE87002471	MN -32	12:8802
CONF-8610134-	(American defense preparedness symposium, Long Beach, CA, USA, 27-29 Oct 1986)			
2	*See* SAND-86-2127C	E 1.99: DE86016117	MN -45	12:8555
CONF-8610135-	(14. water reactor safety information meeting, Gaithersburg, MD, USA, 27-31 Oct 1986)			
4	NTIS, PC A02/MF A01 - GPO	TI87002401	MN -78	12:8195
5	*See* SAND-86-2115C	TI87002490	MN -78	12:8212
6	*See* EGG-M-34786	E 1.99: DE87002185	MN -78	12:8204
7	*See* EGG-M-30086	E 1.99: DE87002615	MN -78	12:8203
8	*See* SAND-86-2128C	TI87002495	MN -78	12:8213
12	*See* EGG-M-22686	E 1.99: DE87002603	MN -78	12:8202
13	NTIS, PC A02; 3	DE87002627	MN -78	12:8166
CONF-8610146-	(Southeastern TIMS meeting, Myrtle Beach, SC, USA, 9-10 Oct 1986)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002171	MN -32	12:8786
5	NTIS, PC A02; 3	DE87002410	MN -38	12:8607
CONF-8610147-	(American Welding Society Interagency Mechanical Operations Group and Joint Operation Weapons Operations Group meeting, Albuquerque, NM, USA, 13 Oct 1986)			
1	*See* UCRL-95346	E 1.99: DE87000834	MN -38	12:8452
CONF-8610149-	(Advisory group meeting on comparison of nuclear analytical methods with competitive methods, Oak Ridge, TN, USA, 3-7 Oct 1986)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001829	MN -4	12:8406
CONF-8610157-	(Tritium technology workshop, Tokyo, Japan, 22-24 Oct 1986)			
1	*See* LA-UR-86-3558	E 1.99: DE87001965	MN -20d	12:8772
2	*See* EGG-M-33986	E 1.99: DE87002600	MN -20d	12:8771
CONF-8610164-	(International Atomic Energy Agency conference, Bologna, Italy, 6-10 Oct 1986)			
1	*See* UCRL-95397	E 1.99: DE87000601	MN -34D	12:8712
CONF-8610167-	(Isovector excitations in nuclei, Vancouver, Canada, 7-8 Oct 1986)			
1	*See* LA-UR-86-3588	E 1.99: DE87001970	MN -34C	12:8705
CONF-8610168-	(6. international meeting of test stations for wind turbines (IMTS 1986), Schnittlingen, F.R. Germany, 2-3 Oct 1986)			
1	*See* ECN-86-132		ND -60	12:8137
CONF-861110-	(American Physical Society Plasma Physics Division meeting, Baltimore, MD, USA, 3-7 Nov 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002201	MN -20	12:8730
CONF-861111-	(Conference on magnetism and magnetic materials, Baltimore, MD, USA, 17-21 Nov 1986)			
14	*See* LBL-22444	E 1.99: DE87002563	MN -25	12:8350
CONF-861114-	(9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986)			
22	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001825	MN -34A	12:8674
24	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002408	MN -34A	12:8675
25	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002402	MN -34A	12:8676
26-Rev.1	*See* UCRL-95414-Rev.1	E 1.99: DE87001353	MN -34A	12:8681
CONF-861146-	(AIChE winter annual meeting, Miami, FL, USA, 2-7 Nov 1986)			
8	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87000864	MN -90e	12:7906
CONF-861181-	(3. annual conference on improving building energy efficiency in hot and humid climates, Arlington, TX, USA, 17-19 Nov 1986)			
2	NTIS, PC A02; 3	DE87001677	MN -95d	12:8277
CONF-861188-	(Symposium on galvanic corrosion, Phoenix, AZ, USA, 4 Nov 1986)			
1	*See* DP-MS-86-111	E 1.99: DE87002656	MN -70	12:8344
CONF-861211-	(American Society of Mechanical Engineers winter meeting, Anaheim, CA, USA, 7-12 Dec 1986)			
15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001701	MN -13	12:8243
17	NTIS, PC A02; 3	DE87002621	MN -95d	12:8278

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CONF-870101-	(American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting, New York, NY, USA, 18-21 Jan 1987)			
1	*See* LA-UR-86-1203	E 1.99: DE86010174	MN -59A	12:8098
2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87000399	MN -95d	12:8279
CONF-870102-	(4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987)			
4	*See* UCRL-95474	E 1.99: DE87001361	MN -25	12:8354
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002419	MN -25	12:8383
CONF-870103-	(2. international conference on constitutive laws for engineering materials, Tucson, AZ, USA, 5-10 Jan 1987)			
1	*See* UCRL-93993	E 1.99: DE86010970	MN -25	12:8353
2	*See* LA-UR-86-1931	E 1.99: DE86012386	MN -25	12:8663
3	*See* LA-UR-86-2003	E 1.99: DE86012375	MN -25	12:8346
5	*See* SAND-86-0074C	E 1.99: DE86014152	MN -25	12:8666
CONF-870104-	(Annual reliability and maintainability symposium, Philadelphia, PA, USA, 27-29 Jan 1987)			
1	*See* SAND-86-0424C	E 1.99: DE86013577	MN -88	12:7901
CONF-870105-	(International conference on integrated optics and optical fiber communication (IOOC), Reno, NV, USA, 19-22 Jan 1987)			
1	*See* SAND-86-1736C	E 1.99: DE86010138	MN -38	12:8450
CONF-870108-	(20. annual Hawaii international conference on system sciences, Honolulu, HI, USA, 6-9 Jan 1987)			
1	*See* LA-UR-86-2662	E 1.99: DE86013818	MN -32	12:8801
3	*See* SAND-86-2495C	E 1.99: DE87002058	MN -38	12:8462
CONF-870109-	(International welding conference, Tiruchchirappalli, India, 12-14 Jan 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014217	MN -25	12:8333
CONF-870111-	(Annual battery conference on application and advances, Long Beach, CA, USA, 13-15 Jan 1987)			
1	*See* SAND-86-2248C	E 1.99: DE87001417	MN -94ca	12:8222
CONF-870114-	(IEEE/OSA topical meeting on picosecond electronics and optoelectronics, Lake Tahoe, NV, USA, 14-16 Jan 1987)			
1	*See* SAND-86-1896C	E 1.99: DE86015824	MN -37	12:8460
CONF-870119-	(Topical meeting on laser applications to chemical analysis, Incline Village, NV, USA, 26-29 Jan 1987)			
1	*See* UCRL-95499	DE87001356	MN -38	12:8552
CONF-870128-	(6. symposium on meteorological observations and instrumentation, New Orleans, LA, USA, 12-16 Jan 1987)			
1	*See* UCRL-94702	E 1.99: DE87000532	MN -11	12:8563
CSRD-				
551	*See* DOE/ER/25001-9	E 1.99: DE87002099	MN -32	12:8797
DEMO-				
84/ 3	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900234	MN -78	12:8201
84/ 14	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900236	MN -34	12:8724
DHHS/PUB/NIOSH-				
85-114	*See* PB-87-101838/XAB			12:8239
DOE/AL/33162-				
T1	NTIS, PC A10/MF A01; 1	DE87001991	ND -66	12:8106
DOE/BP-				
676	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87002664	MN -95d	12:8280
730	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87002957	MN -97a	12:8159
DOE/BP/21216-				
1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87002219	MN -11	12:8654
DOE/BP/21237-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002221	MN -11	12:8020
DOE/BP/22493-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002222	MN -11	12:8021
DOE/BP/34796-				
2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87002972	MN -48	12:8594
DOE/BP/39643-				
1	NTIS, PC A03; 3	DE87002218	MN -11	12:8022
DOE/CE/23858-				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002442	MN -95d	12:8281
DOE/CE/24442-				
T1	National Institute of Building Sciences, Publications Department, 1015 Fifteenth Street, N.W., Suite 700, Washington, DC 20005	TI87002214	ND -95c	12:8251
DOE/CE/40626-				
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87003169	STD -95f	12:8297
DOE/CE/40702-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002427	MN -4	12:8384
DOE/CS/40005-				
T6	NTIS, PC A08; 3	DE87002828	MN -95f	12:8298
DOE/EA-				
0317	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87002840	MN -70A	12:7983
DOE/EIA-				
0118(85)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87002457	MN -98A	12:7916
0202(86/ 4Q)	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87002259	MN -98	12:7935
0380(86/ 08)	NTIS, PC A08/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87002261	MN -98B	12:7936

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0477(85)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87002620	MN -98	12:7961
DOE/ER/03244-125	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002034	MN -34D	12:8698
DOE/ER/06034-T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002499	MN -4	12:8425
DOE/ER/10699-T5	NTIS, PC A02; 3		DE87002216	MN -28	12:8488
DOE/ER/10950-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002820	MN -25	12:8371
DOE/ER/13014-T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002323	MN -11	12:8659
DOE/ER/13147-2-Pt.6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87000762	MN -34	12:8725
2-Pt.8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87000764	MN -34	12:8726
DOE/ER/13503-1	NTIS, PC A03; 3		DE87001757	MN -4	12:8429
DOE/ER/13619-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002400	MN -4	12:8407
DOE/ER/25001-9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002099	MN -32	12:8797
DOE/ER/40272-20	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002445	MN -34D	12:8700
DOE/ER/45141-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001877	MN -25	12:8343
DOE/ER/45193-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002361	MN -25	12:8412
DOE/ER/45216-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002769	MN -25	12:8457
DOE/ER/45222-1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87002768	MN -34A	12:8678
DOE/ER/52109-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87000636	MN -20	12:8770
DOE/ER/53223-16	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002519	MN -20g	12:8731
18	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002520	MN -20f	12:8732
DOE/ER/60197-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002539	MN -11	12:8656
DOE/ER/60431-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002094	MN -25	12:8408
DOE/ER/70293-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001753	MN -61	12:8603
DOE/ET/12139-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002434	MN -11	12:8657
DOE/ET/34030-11	NTIS (US Sales Only), PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002731	STD -78	12:8168
DOE/ET/51013-197	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002772	MN -20f	12:8733
198	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002723	MN -20	12:8734
DOE/ET/53088-252	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002036	MN -20g	12:8735
DOE/EV/02725-T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002721	MN -48	12:8604
DOE/EV/60301-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002443	MN -11	12:8595
DOE/FE-0074	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87000856	MN -92	12:7946
DOE/FE/55014-T24	NTIS, PC A07; 3		DE87002800	MN -90c	12:7870
T25	NTIS, PC A13; 3		DE87002463	MN -90c	12:7896
DOE/FE/60181-2125	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87001013	STD -90	12:7868
2126	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001014	STD -90	12:7907
2127	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001015	STD -90	12:7908
DOE/IG-0008/ 10-2	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830; 1		TI87003044	STD -13	12:8787
0010/ 3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86015885	MN -13	12:8788
0232	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830; 1		TI87002865	STD -13	12:8789
DOE/LC/00022-2164	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86006598	MN -90i	12:8152
DOE/LC/10924-2168	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86006574	STD -90i	12:8624
DOE/MA-0264	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002515	MN -13	12:8784
DOE/MC/21119-T9	NTIS, PC A02; 3		DE86010302	MN -92	12:7951
DOE/MC/21179-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010428	MN -92a	12:7947
DOE/MC/22059-T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000525	MN -90c	12:7871
DOE/METC-86/ 2027	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86006577	STD -90c	12:7872
DOE/NASA-0168-10	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002761	MN -96	12:8314

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0311-1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87002994	STD -96	12:8318
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7002454	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002454	MN -66	12:8105
DOE/NV/10384-				
01	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002474	MN -11	12:8567
DOE/PC/50035-				
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002451	MN -90b	12:7873
DOE/PC/50816-				
12	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87002303	MN -90d	12:7874
DOE/PC/60036-				
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002940	MN -90a	12:7875
DOE/PC/62999-				
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002254	MN -90a	12:7881
DOE/PC/70022-				
T3	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE87002452	MN -92	12:8002
DOE/PC/70030-				
T3	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE87001393	MN -90d	12:7992
T4	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87001792	MN -90d	12:7993
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5-Pt.1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87000956	STD -90a	12:7882
6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002949	MN -90a	12:7883
T7	NTIS, PC A02; 3	DE87002263	MN -90a	12:7909
DOE/PC/70796-				
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002298	MN -90a	12:7869
DOE/PC/70803-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001943	MN -90a	12:7903
DOE/PC/70809-				
T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002297	MN -90	12:7884
DOE/PC/80515-				
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002449	MN -90c	12:7888
DOE/PC/80524-				
T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002933	MN -90a	12:7904
DOE/PC/80529-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001777	MN -90a	12:7910
DOE/PC/80911-				
T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002475	MN -90a	12:7885
DOE/PC/91271-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002461	MN -90a	12:7899
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87/ 2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87002511	STD -90i	12:8568
87/ 3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002512	STD -90i	12:8625
DOE/RA/50153-				
T2	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE86009836	STD -97a	12:8160
DOE/RW-				
0006-Rev.2	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87002346	STD -70	12:7964
0101	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002725	STD -70	12:7965
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0054	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87002987	MN -2	12:8245
DOE/SF/15599-				
T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87002834	MN -59A	12:8086
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87-1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87003058	MN -70	12:7966
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86-96	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002640	MN -70	12:7967
86-108	NTIS, PC A02; 3	DE87002658	MN -70B	12:7968
86-111	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002656	MN -70	12:8344
86-116	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002645	MN -70B	12:8385
86-172	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002654	MN -70B	12:7969
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85-133-10/ 86-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002692	MN -23	12:7990
85-615	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87002641	MN -70	12:8386
86-271	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002644	MN -25	12:8177
86-437	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002651	MN -37	12:8547
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84-96	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002642	MN -86	12:7958
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1886	*See* N-86-26629			12:8315
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85-168	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8111
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85-185	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8114
85-192	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -25	12:8436
85-194	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -38	12:8437
86-001	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8115
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86-068	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8118
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86-074	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8124
86-075	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8125
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86-078	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8128
86-105	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -90e	12:7911
86-117	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8129
86-118	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:8130
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86-142	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -90i	12:7897
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ECRC/M-				
1909	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -95	12:8299
2054	Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK		ND -95e	12:8310
2065	Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK		ND -95d	12:8282
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2073	Electricity Council Research Centre, Capenhurst, Chester CH1 6ES, UK		ND -97	12:8161
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12344	*See* DOE/NASA-0168-10	E 1.99: DE87002761	MN -96	12:8314
EFI-				
785(12) -85	NTIS (US Sales Only), PC A02/MF A01	DE87700233	MN -37	12:8528
810(37) -85	NTIS (US Sales Only), PC A02/MF A01	DE87700242	MN -28	12:8489
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10282-1124	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001788	MN -41	12:8587
10282-2097	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001782	MN -37	12:8529
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30086	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002615	MN -78	12:8203
33986	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002600	MN -20d	12:8771
34786	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002185	MN -78	12:8204
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86/ 2	NTIS (US Sales Only), PC A03/MF A01; 1	DE87900155	MN -32	12:8798
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34	*See* ESC-WR-86-08		ND -98	12:8244
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EPRI-CS-				
4736	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920072	ND -90	12:8147
4748	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920073	ND -93	12:8148
EPRI-EL-				
4658-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920080	ND -97d	12:8149
ERA-				
86-0038	ERA Technology, Cleeve Road, Leatherhead, Surrey KT22 7SA, UK		ND -97	12:8162
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35	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98F	12:8300
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85-29	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -97b	12:8257
86-02	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8313
86-03	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8230
86-04	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8231
86-07	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -92	12:7930
86-08	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8244
86-09	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -92	12:8232

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86-11	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -97b	12:8258
86-12	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -61E	12:8301
86-14	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8273
86-15	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:8233
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5041	ESDU			12:8455
5042	ESDU			12:8438
ETSU-WV-				
1570-P20	British Library, Boston Spa, Wetherby, West Yorks		ND -97e	12:8107
1570-P22	British Library, Boston Spa, Wetherby, West Yorks		ND -97e	12:8108
1570-P23	British Library, Boston Spa, Wetherby, West Yorks		ND -97e	12:8109
1570-P25	British Library, Boston Spa, Wetherby, West Yorks		ND -97e	12:8110
FCR-				
78264A	*See* PB-87-102174/XAB			12:8267
FO-				
34/ 86	*See* OEFZS-4365	DE87700240	MN -2	12:8791
35/ 86	*See* OEFZS-4323e	DE87700239	MN -2	12:8790
FOA-C-				
20611-E3	*See* STEV-VIND-86-5	DE87750361	MN -60	12:8145
GARRETT-				
21-5869	*See* N-86-26629			12:8315
GAT-T-				
3376-Add.1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002856	MN -37	12:8530
GEPP-TIS-				
965	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003086	MN -13	12:8458
GSF-BPT-				
1/ 86	NTIS (US Sales Only), PC A04/MF A01	DE87750297	MN -11	12:8569
3/ 86	NTIS (US Sales Only), PC A11/MF A01; 1	DE87750302	MN -11	12:8570
IFSR-				
252	*See* DOE/ET/53088-252	E 1.99: DE87002036	MN -20g	12:8735
IFVE-FTO-				
85-42	NTIS (US Sales Only), PC A03/MF A01	DE87700230	MN -37	12:8531
IFVE-OEF-				
85-150	NTIS (US Sales Only), PC A02/MF A01	DE87700231	MN -37	12:8532
IFVE-ONF-				
85-72	NTIS (US Sales Only), PC A02/MF A01	DE87700232	MN -37	12:8533
IKU-R-				
01.0244.00/ 01/ 86	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750374	MN -92a	12:7920
02.0706.00/ 02/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87750380	MN -92	12:7937
02.0706.00/ 04/ 85	NTIS (US Sales Only), PC A03/MF A01	DE87750372	MN -92a	12:7938
02.0706.00/ 06/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87750383	MN -92	12:7939
02.0706/ 03/ 85	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750381	MN -92	12:7940
02.0706.10/ 01/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87750382	MN -92	12:7941
03.0732.00/ 01/ 85	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750377	MN -92a	12:7942
05/ 1704.00/ 02/ 85	NTIS (US Sales Only), PC A05/MF A01	DE87750379	MN -92	12:7943
08.2600.00/ 01/ 85	NTIS (US Sales Only), PC A07/MF A01; 1	DE87750378	MN -92a	12:7923
08.2600.03/ 04/ 86	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750373	MN -92a	12:7924
08.2610.00/ 01/ 85	NTIS (US Sales Only), PC A07/MF A01; 1	DE87750376	MN -92a	12:7925
08.2613.02/ 01/ 85	NTIS (US Sales Only), PC A11/MF A01; 1	DE87750375	MN -92a	12:7926
INDC(EUR)-				
020/ 6	*See* NEANDC(E)-272-U-Vol.3	DE87900271	MN -34C	12:8703
INIS-mf-				
10512	NTIS (US Sales Only), PC A06/MF A01	DE87700241	MN -34	12:8727
INIS-SU-				
375	NTIS (US Sales Only), PC A03/MF A01	DE87700225	MN -28	12:8481
INP-				
1212/ PM	NTIS (US Sales Only), PC A04/MF A01	DE87700236	MN -32	12:8800
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597	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002730	MN -90i	12:7889
IS-T-				
1179-01/ 86	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86016017	MN -4	12:8413
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88	*See* ANL-HEP-CP-86-62	E 1.99: DE87001508	MN -34D	12:8687
93	*See* ANL-HEP-CP-86-70	E 1.99: DE87001499	MN -34D	12:8688
94	*See* ANL-HEP-CP-86-71	E 1.99: DE87001511	MN -34D	12:8689
95	*See* ANL-HEP-CP-86-72	E 1.99: DE87001503	MN -34D	12:8690
383	*See* ANL-HEP-CP-86-54	E 1.99: DE87001501	MN -34D	12:8685
384	*See* ANL-HEP-CP-86-55	E 1.99: DE87001504	MN -34D	12:8686
386	*See* ANL-HEP-CP-86-50	E 1.99: DE87001502	MN -34D	12:8684
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02/ 85	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750389	MN -95f	12:8302
IVO-B-				
05/ 86	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750390	MN -90i	12:7912
06/ 86	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750391	MN -61F	12:8017
07/ 86	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750392	MN -90i	12:8153
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86/ 1	NTIS (US Sales Only), PC A04/MF A01	DE87700227	MN -80	12:8178
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5942	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001852	MN -15	12:7989
K/PS-					
5068	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002593	MN -71	12:8441
KFK-					
4063	NTIS (US Sales Only), PC A07/MF A01; 1		DE87900160	MN -25	12:8372
KFK-PEF-					
4-Vol.1	NTIS (US Sales Only), PC A20/MF A01; 1		DE87750294	MN -11	12:8626
KFTI-					
84-7	NTIS (US Sales Only), PC A02/MF A01		DE87700235	MN -2	12:8549
84-19	NTIS (US Sales Only), PC A02/MF A01		DE87700237	MN -32	12:8521
KMU-HEP-					
85-05	NTIS (US Sales Only), PC A04/MF A01		DE87700226	MN -28	12:8482
KTH-KTR-					
86-15-Pt.1	*See* STEV-BF-86-5-Pt.1		DE87750340	MN -90c	12:7877
86-15-Pt.2	*See* STEV-BF-86-5-Pt.2		DE87750341	MN -90c	12:7878
LA-					
10800-MS	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002242	STD -41	12:7917
LA-UR-					
86-1203	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010174	MN -59A	12:8098
86-1931	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86012386	MN -25	12:8663
86-2003	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86012375	MN -25	12:8346
86-2662	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013818	MN -32	12:8801
86-3558	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001965	MN -20d	12:8772
86-3588	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87001970	MN -34C	12:8705
LBL-					
21295	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002561	MN -28	12:8512
21472-Rev.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002570	MN -34D	12:8728
21765	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002573	MN -34C	12:8710
21788	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002564	MN -25	12:8347
21789	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002567	MN -25	12:8348
21804	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001880	MN -92	12:7927
22082	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002542	MN -25	12:8387
22182	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87001720	MN -34C	12:8537
22228	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87002568	MN -34A	12:8550
22239	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002577	MN -25	12:8349
22249	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002578	MN -4	12:8415
22293	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87001727	MN -48	12:7994
22303	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002549	MN -34D	12:8701
22316	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002560	MN -34	12:8679
22342	NTIS, PC A02; 3		DE87002548	MN -28	12:8483
22343	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002574	MN -34C	12:8670
22368	NTIS, PC A03; 3		DE87002550	MN -25	12:8373
22444	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002563	MN -25	12:8350
LRP-					
219/ 83	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900219	MN -20	12:8738
227/ 83	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900190	MN -20g	12:8739
229/ 83	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900119	MN -20	12:8773
233/ 84	NTIS (US Sales Only), PC A04/MF A01; 1		DE87900195	MN -20	12:8740
234/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87900196	MN -20	12:8741
235/ 84	NTIS (US Sales Only), PC A03/MF A01		DE87900177	MN -20	12:8742
239/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87900200	MN -20	12:8743
241/ 84	NTIS (US Sales Only), PC A04/MF A01; 1		DE87900180	MN -20	12:8744
245/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87900194	MN -20	12:8745
248/ 84	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900178	MN -20	12:8746
249/ 84	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900179	MN -20	12:8747
254/ 85	NTIS (US Sales Only), PC A02/MF A01		DE87900184	MN -20	12:8748
255/ 85	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900183	MN -20a	12:8774
257/ 85	NTIS (US Sales Only), PC A02/MF A01		DE87900182	MN -20	12:8749
259/ 85	NTIS (US Sales Only), PC A02/MF A01		DE87900181	MN -20a	12:8750
MF-					
110	*See* DOE/ER/53223-16	E 1.99:	DE87002519	MN -20g	12:8731
112	*See* DOE/ER/53223-18	E 1.99:	DE87002520	MN -20f	12:8732
MLM-					
3389	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002348	STD -4	12:8409
3395	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002682	STD -25	12:8351
MRC/WDC-R-					
105	*See* UCRL-15851	E 1.99:	DE87002507	MN -38	12:8465
MTI-					
85SESD24	*See* DOE/NASA-0311-1	E 1.99:	DE87002994	STD -96	12:8318
N-					
86-26629	NTIS, PC A03/MF A01				12:8315
86-29011	NTIS, PC A02/MF A01				12:8430
86-29026	NTIS, PC A02/MF A01				12:8410
86-29692	NTIS, PC A03/MF A01				12:8388
86-29752	NTIS, PC A02/MF A01				12:8671
86-30617	NTIS, PC A02/MF A01				12:8672
86-31377	NTIS, PC A04/MF A01				12:8374
NAS-					
1.15:88420	*See* N-86-29752				12:8671
1.15:88423	*See* N-86-30617				12:8672
1.15:88426	*See* N-86-29692				12:8388
1.15:88434	*See* N-86-29026				12:8410

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1.15:88459	*See* N-86-29011			12:8430
1.26:176966	*See* N-86-31377			12:8374
NASA-CR-				
175042	*See* DOE/NASA-0311-1	E 1.99: DE87002994	STD -96	12:8318
176966	*See* N-86-31377			12:8374
179451	*See* N-86-26629			12:8315
179484	*See* DOE/NASA-0168-10	E 1.99: DE87002761	MN -96	12:8314
NASA-TM-				
88420	*See* N-86-29752			12:8671
88423	*See* N-86-30617			12:8672
88426	*See* N-86-29692			12:8388
88434	*See* N-86-29026			12:8410
88459	*See* N-86-29011			12:8430
NBSIR-				
86-3044	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87002760	MN -20	12:8442
86/ 3425	*See* PB-87-103271/XAB			12:7919
NEANDC(E)-				
272-U-Vol.3	NTIS (US Sales Only), PC A05/MF A01; 1	DE87900271	MN -34C	12:8703
NIPER-				
164	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE86000303	STD -92	12:7928
NLR-MP-				
85014-U	National Aerospace Lab. NLR, P.O. Box 90502, 1006 BM Amsterdam, Netherlands		ND -60	12:8443
NP-				
7750293	NTIS (US Sales Only), PC A11/MF A01; 1	DE87750293	MN -97	12:8259
7750296	NTIS (US Sales Only), PC A06/MF A01; 1	DE87750296	MN -11	12:8571
7750299	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750299	MN -11	12:8237
7750300	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750300	MN -95d	12:8283
7750344	NTIS (US Sales Only), PC A07/MF A01; 1	DE87750344	MN -95e	12:8303
7750345	NTIS (US Sales Only), PC A06/MF A01; 1	DE87750345	MN -97	12:8260
7750346-Pt.1	NTIS (US Sales Only), PC A06/MF A01; 1	DE87750346	MN -11	12:8253
7750347	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750347	MN -97b	12:8261
7750348	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750348	MN -90	12:8255
7750349	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750349	MN -90	12:8256
7750350	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750350	MN -48	12:8655
7750362	NTIS (US Sales Only), PC A02/MF A01; 1	DE87750362	MN -98	12:8252
7750363	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750363	MN -98	12:8234
7750364	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750364	MN -97	12:8262
7750365	NTIS (US Sales Only), PC A02/MF A01	DE87750365	MN -98	12:8254
7750366	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750366	MN -95e	12:8018
7750367	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750367	MN -95d	12:8248
7750368	NTIS (US Sales Only), PC A04; 3	DE87750368	MN -97	12:8263
7750369	NTIS (US Sales Only), PC A02/MF A01	DE87750369	MN -97	12:8304
7750370	NTIS (US Sales Only), PC A04/MF A01	DE87750370	MN -95d	12:8311
7750384	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750384	MN -95f	12:8305
7750385	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750385	MN -95e	12:8312
7750386	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750386	MN -95f	12:8306
7750387	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750387	MN -95f	12:8307
7750388	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750388	MN -95f	12:8308
7750394	NTIS (US Sales Only), PC A07/MF A01; 1	DE87750394	MN -95f	12:8309
7770022	NTIS (US Sales Only), PC A07/MF A01; 1	DE87770022	MN -90	12:7876
7770023	NTIS (US Sales Only), PC A07/MF A01; 1	DE87770023	MN -60	12:8142
7770025-Pt.2	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770025	MN -11	12:7934
7900037	Wisconsin Division of State Energy and Coastal Management, Department of Administration, PO Box 7868, Madison, WI 53707	TI87900037	MN -98F	12:8249
7900118	Superintendent of Documents, Congressional Sales Office, U.S. GPO, Washington, DC 20402	TI87900118	MN -98B	12:7944
7900272	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900272	MN -28	12:8513
7900273	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900273	MN -28	12:8514
7900274	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900274	MN -34C	12:8716
NTB-				
86-06	Nagra, Ch-5401 Baden, Switzerland		ND -70	12:7970
86-09	Nagra, Ch-5401 Baden, Switzerland		ND -70	12:7971
86-13	Nagra, Ch-5401 Baden, Switzerland		ND -70	12:8389
86-14	Nagra, Ch-5401 Baden, Switzerland		ND -70	12:7972
NUREG-				
0040-Vol.10-No.3	NTIS, PC A10/MF A01 - GPO	TI87900163	MN -2	12:8176
0304-Vol.11-No.3	NTIS, PC A04 - GPO	DE87900296	MN -2	12:8173
0325-Rev.9	NTIS, PC A04 - GPO; 3	DE87900247	MN -2	12:8246
0540-Vol.8-No.9	NTIS, PC A17 - GPO	DE87900164	MN -2	12:8174
0876-Suppl.7	NTIS, PC A05/MF A01 - GPO	TI87900121	MN -78	12:8208
0940-Vol.5-No.3	NTIS, PC A18/MF A01 - GPO	TI87900120	MN -2	12:8247
1101-Vol.3	NTIS, PC A08/MF A01 - GPO	TI87900158	MN -70B	12:7984
NUREG/CR-				
3955	NTIS, PC A03/MF A01 - GPO	TI86015368	MN -41	12:8622
4447	NTIS, PC A06/MF A01 - GPO	TI87900161	MN -71	12:7985
4469-Vol.2	NTIS, PC A05/MF A01 - GPO	TI87002466	MN -78	12:8175
4492	NTIS, PC A05/MF A01 - GPO	TI87002071	MN -11	12:8602
4522	NTIS, PC A03/MF A01 - GPO	TI87900162	MN -78	12:8209
4611	NTIS, PC A08/MF A01 - GPO	TI87002310	MN -78	12:8167
4743	NTIS, PC A03/MF A01 - GPO	TI87002355	MN -41	12:8538
OEFZS-				
4323e	NTIS (US Sales Only), PC A03/MF A01	DE87700239	MN -2	12:8790

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4365	NTIS (US Sales Only), PC A03/MF A01		DE87700240	MN -2	12:8791
OEFZS-A-					
0856	Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria			ND -32	12:8235
ORNL/DSRD/TM-					
1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE87002989	MN -32	12:8792
ORNL/M-					
155	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86014930	MN -11	12:8588
215	*See* DOE/RW-0006-Rev.2	E 1.99:	DE87002346	STD -70	12:7964
ORNL/Sub-					
85-00200/ 1	NTIS PC E12/MF $7.30; 1 (GPO Dep.)	E 1.99:	DE87002979	STD -97a	12:8163
85-27497/ 1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002968	MN -95d	12:8284
85-97368/ 2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002962	MN -70	12:7986
ORNL/TM-					
9602	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002983	STD -20f	12:8751
9800	*See* NUREG/CR-3955		TI86015368	MN -41	12:8622
9818	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002964	MN -11	12:8580
9867	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002326	MN -11	12:8572
9879	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002975	STD -70B	12:8390
9994	NTIS, PC A17/MF A01; 1		DE87002953	STD -20f	12:8775
9996	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002974	MN -70A	12:7987
10076	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002963	MN -41	12:8589
10096	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002966	STD -20a	12:8776
10168	NTIS, PC A06/MF A01; 1 (GPO Dep.)	A 1.99:	DE87002074	MN -41	12:8722
10171	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002967	STD -20g	12:8777
10199	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002990	STD -20f	12:8752
10204	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002977	STD -90d	12:7918
10207	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002971	MN -34C	12:8539
10243	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002982	MN -32	12:8793
OTA-ISC-					
312	*See* PB-87-100343/XAB				12:8558
OTA-SET-					
304	*See* PB-87-100319/XAB				12:8238
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)				
4,616,184					12:8660
4,621,577					12:8780
4,621,761					12:8356
4,622,049					12:8419
4,622,067					12:8355
4,622,200					12:8541
4,622,215					12:8375
PB-					
86-239449/ XAB	NTIS PC PC E04/MF A01				12:7932
86-241007/ XAB	NTIS, PC A03/MF A01				12:8650
86-241866/ XAB	NTIS, PC A08/MF A01				12:8600
86-243730/ XAB	NTIS, PC A07/MF A01				12:8285
87-100046/ XAB	NTIS, PC A10/MF A01				12:8573
87-100319/ XAB	NTIS, PC A17/MF A01				12:8238
87-100343/ XAB	NTIS, PC A03/MF A01				12:8558
87-100533/ XAB	NTIS, PC A04/MF A01				12:8574
87-100582/ XAB	NTIS, PC A02/MF A01				12:8586
87-101234/ XAB	NTIS, PC A08/MF A01				12:8575
87-101770/ XAB	NTIS, PC A08/MF A01				12:7890
87-101838/ XAB	NTIS, PC A12/MF A01				12:8239
87-101846/ XAB	NTIS, PC A04/MF A01				12:7900
87-102133/ XAB	NTIS, PC A05/MF A01				12:7957
87-102141/ XAB	NTIS, PC A07/MF A01				12:7952
87-102158/ XAB	NTIS, PC A03/MF A01				12:7886
87-102174/ XAB	NTIS, PC A13/MF A01				12:8267
87-102190/ XAB	NTIS, PC A14/MF A01				12:7953
87-102208/ XAB	NTIS, PC A25/MF A01				12:7954
87-102331/ XAB	NTIS, PC A05/MF A01				12:8576
87-102356/ XAB	NTIS, PC A03/MF A01				12:8598
87-102364/ XAB	NTIS, PC A06/MF A01				12:8577
87-102372/ XAB	NTIS, PC A06/MF A01				12:8578
87-103271/ XAB	NTIS, PC A07/MF A01				12:7919
87-103628/ XAB	NTIS, PC A13/MF A01				12:8579
87-103727/ XAB	NTIS, PC A02/MF A01				12:8449
87-105797/ XAB	NTIS, PC A04/MF A01				12:7933
87-107769/ XAB	NTIS, PC A09/MF A01				12:8581
87-108072/ XAB	NTIS, PC A07/MF A01				12:8240
PFC/RR-					
86-22	*See* DOE/ET/51013-197	E 1.99:	DE87002772	MN -20f	12:8733
86-23	*See* DOE/ET/51013-198	E 1.99:	DE87002723	MN -20	12:8734
PNL-					
5711-Vol.2	*See* NUREG/CR-4469-Vol.2		TI87002466	MN -78	12:8175
5728	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002838	MN -71	12:7959
5737	*See* NUREG/CR-4492		TI87002071	MN -11	12:8602
5859	*See* NUREG/CR-4611		TI87002310	MN -78	12:8167
5964	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002839	MN -97	12:8164
5966	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002469	MN -95d	12:8286
6014	*See* NUREG/CR-4743		TI87002355	MN -41	12:8538

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6018	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003092	MN -85	12:7960
6048	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87002728	MN -41	12:8591
6066	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE87002844	MN -70	12:7973
PNL-SA-				
14104	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002064	MN -41	12:8210
14450	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002471	MN -32	12:8802
PPPL-				
2389	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002954	STD -20d	12:8778
PU-				
86-567	*See* ANL-HEP-CP-86-54	E 1.99: DE87001501	MN -34D	12:8685
86-568	*See* ANL-HEP-CP-86-55	E 1.99: DE87001504	MN -34D	12:8686
86-571	*See* ANL-HEP-CP-86-50	E 1.99: DE87001502	MN -34D	12:8684
86-574	*See* ANL-HEP-CP-86-62	E 1.99: DE87001508	MN -34D	12:8687
86-577	*See* ANL-HEP-CP-86-70	E 1.99: DE87001499	MN -34D	12:8688
86-578	*See* ANL-HEP-CP-86-71	E 1.99: DE87001511	MN -34D	12:8689
86-579	*See* ANL-HEP-CP-86-72	E 1.99: DE87001503	MN -34D	12:8690
RAD-				
86-203-023-34-11	*See* PB-87-101234/XAB			12:8575
RAL-				
86-069	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900168	MN -28	12:8474
RHO-RE-EV-				
65P	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87000043	MN -70B	12:7974
89P	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002774	MN -70	12:7975
RHO-RE-SR-				
55P	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003149	MN -70	12:7976
RISO-M-				
2481	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750338	MN -60	12:8143
2531	NTIS (US Sales Only), PC A02/MF A01	DE87750337	MN -60	12:8144
2552	NTIS (US Sales Only), PC A02/MF A01; 1	DE87750336	MN -92a	12:7921
RS-				
275/ 86	*See* OEFZS-A-0856		ND -32	12:8235
SAND-				
85-0323	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87002634	MN -70	12:7977
85-0815	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87003082	MN -70	12:7978
85-0865	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87002087	STD -13	12:8391
85-1001	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002632	STD -71	12:7988
85-1821	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002884	STD -71	12:8444
85-2707	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002630	MN -34	12:8682
85-7018/ 2	NTIS, PC A15/MF A01; 1 (GPO Dep.)	A 1.99: DE87002993	MN -63	12:8062
85-7107	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87003091	MN -70	12:8664
85-7261	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87002633	MN -70	12:8665
86-0074C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014152	MN -25	12:8666
86-0424C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86013577	MN -88	12:7901
86-0679C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001418	MN -38	12:8445
86-0738C	NTIS, PC A02/MF A01 - GPO	TI87002697	MN -78	12:8211
86-1228C	NTIS, PC A02; 3	DE87002480	MN -38	12:8459
86-1364	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87002631	MN -70	12:7979
86-1736C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010138	MN -38	12:8450
86-1826C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002491	MN -25	12:8352
86-1873	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002749	MN -62c	12:8099
86-1896C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86015824	MN -37	12:8460
86-2037C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002695	MN -25	12:8392
86-2038	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002835	STD -25	12:8461
86-2115C	NTIS, PC A02/MF A01 - GPO	TI87002490	MN -78	12:8212
86-2127C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86016117	MN -45	12:8555
86-2128C	NTIS, PC A02/MF A01 - GPO	TI87002495	MN -78	12:8213
86-2163	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87002751	STD -25	12:8393
86-2179C	NTIS, PC A02; 3	DE87002496	MN -38	12:8431
86-2248C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001417	MN -94ca	12:8222
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TH Thailand
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TO Tonga
TR Turkey
TT Trinidad and Tobago
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UG Uganda
US United States of America (USA)
UY Uruguay

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VE Venezuela
VI Virgin Islands of the United States
VN Viet Nam

WS Western Samoa

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YE Yemen
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